Air Force Civil Engineer Center

FORMER
WILLIAMS AIR FORCE BASE

Site ST012
Former Liquid Fuel Storage Area

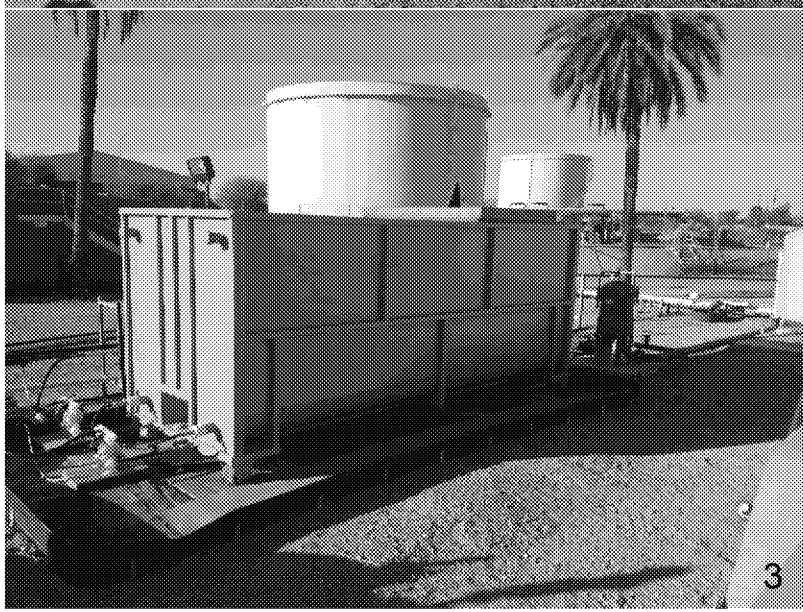
BCT Conference Call
28 June 2018

Site ST012 Outline

- Summary of activities since May BCT call
- Soil vapor extraction update
- Update on JP-4 degradation based on methane at SVE system
- LNAPL monitoring/removal update
- Potential Migration Control Plan Review
- Re-Baseline Data Summary (all data in except for PIANO results)
- Injection Plan Modifications
- Path forward

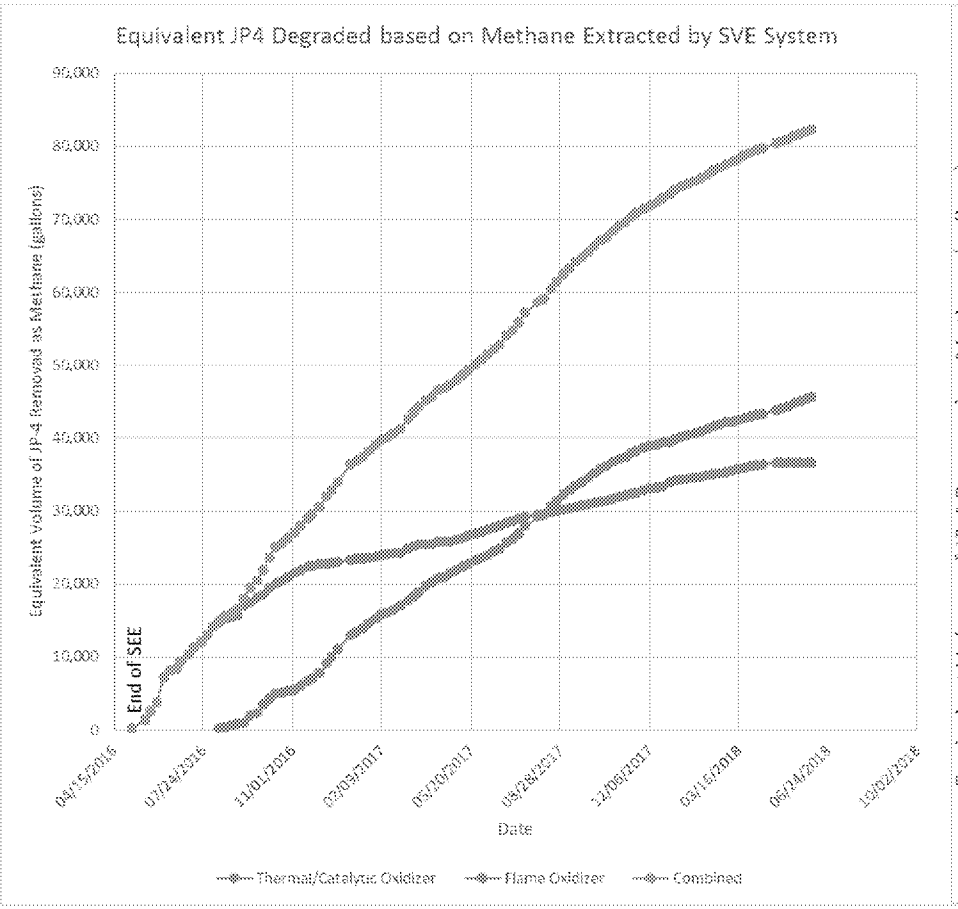
Site ST012 Activities Since May

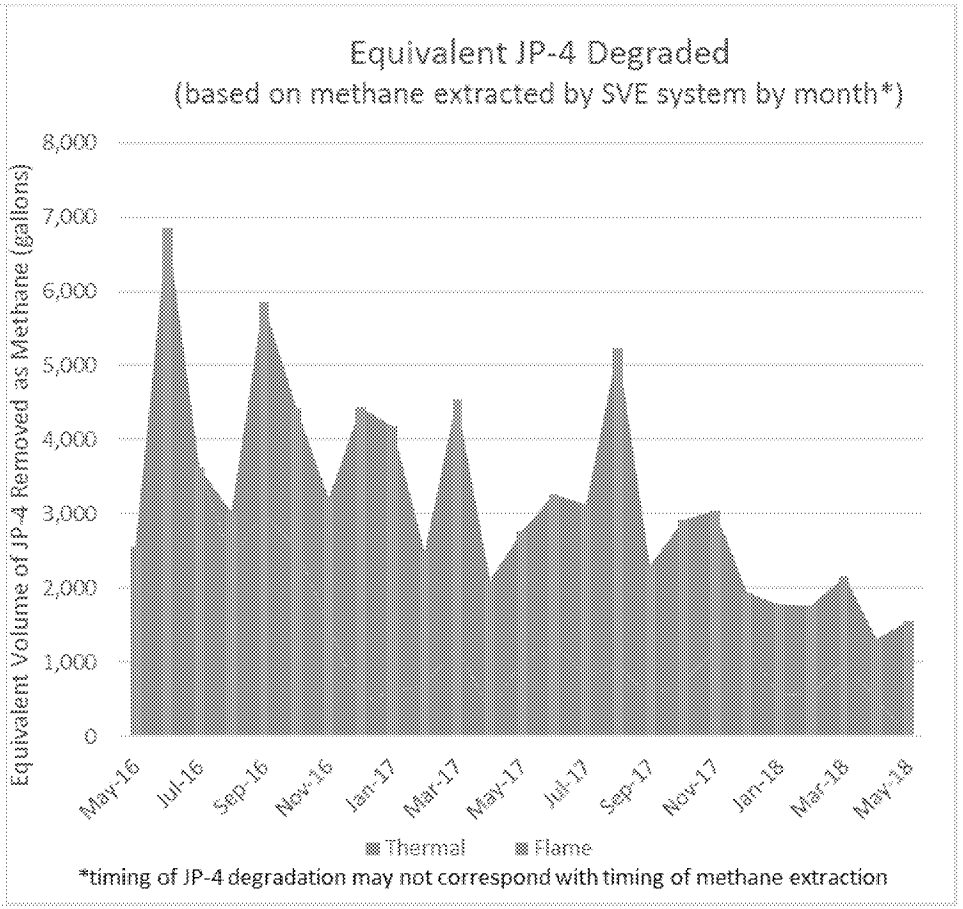
- Continued SVE operation
- Continued LNAPL screening in accessible wells
- Completed EBR pilot study re-baseline sampling
- Completed EBR pilot study construction
- Began receiving sodium sulfate



JP-4 Degradation Based on Methane Removed with SVE (through 6 Jun)

Site ST012 SVE System Equivalent JP-4 Degradation Based on Methane Removed



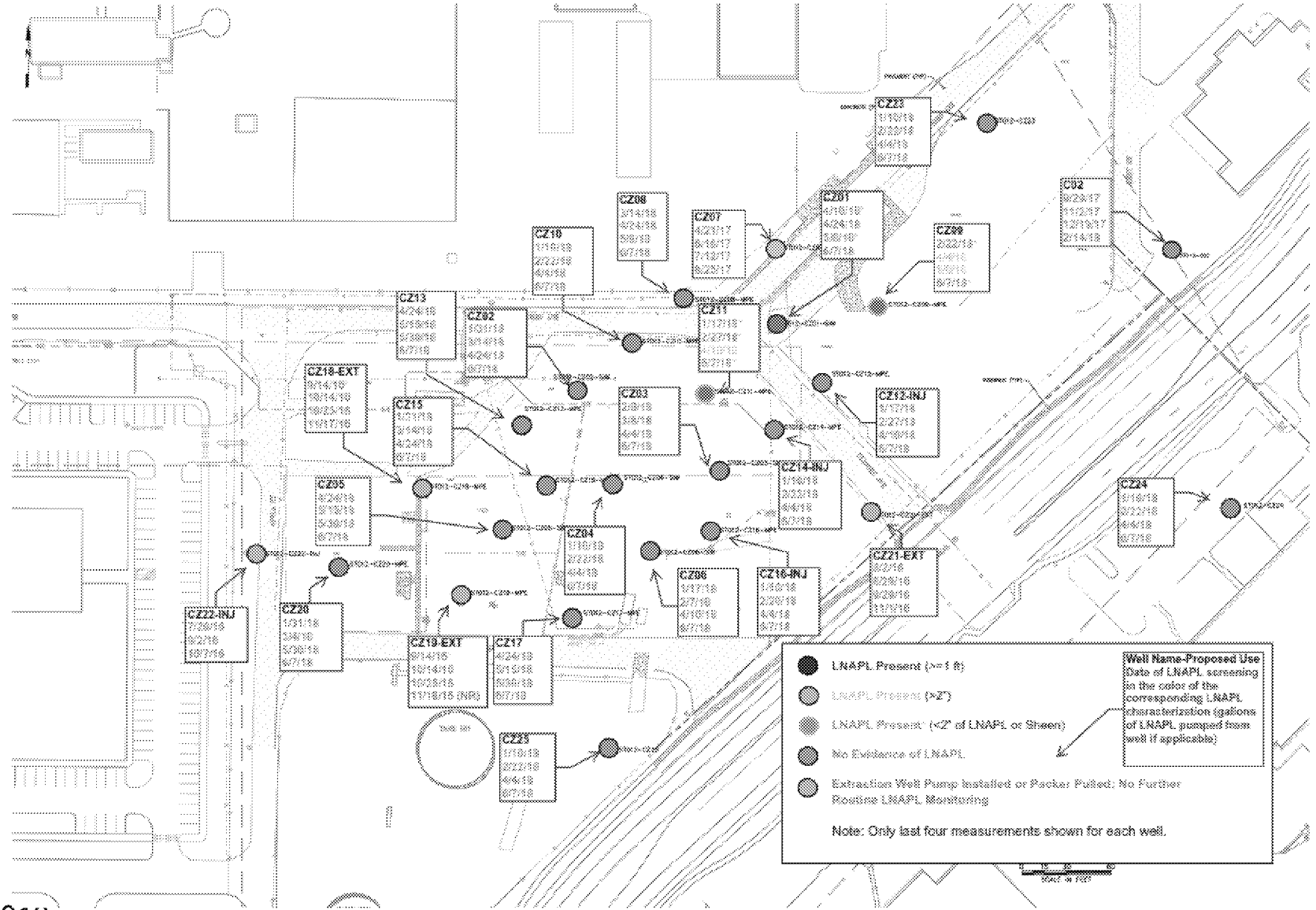


Estimates through 6 Jun 2018.

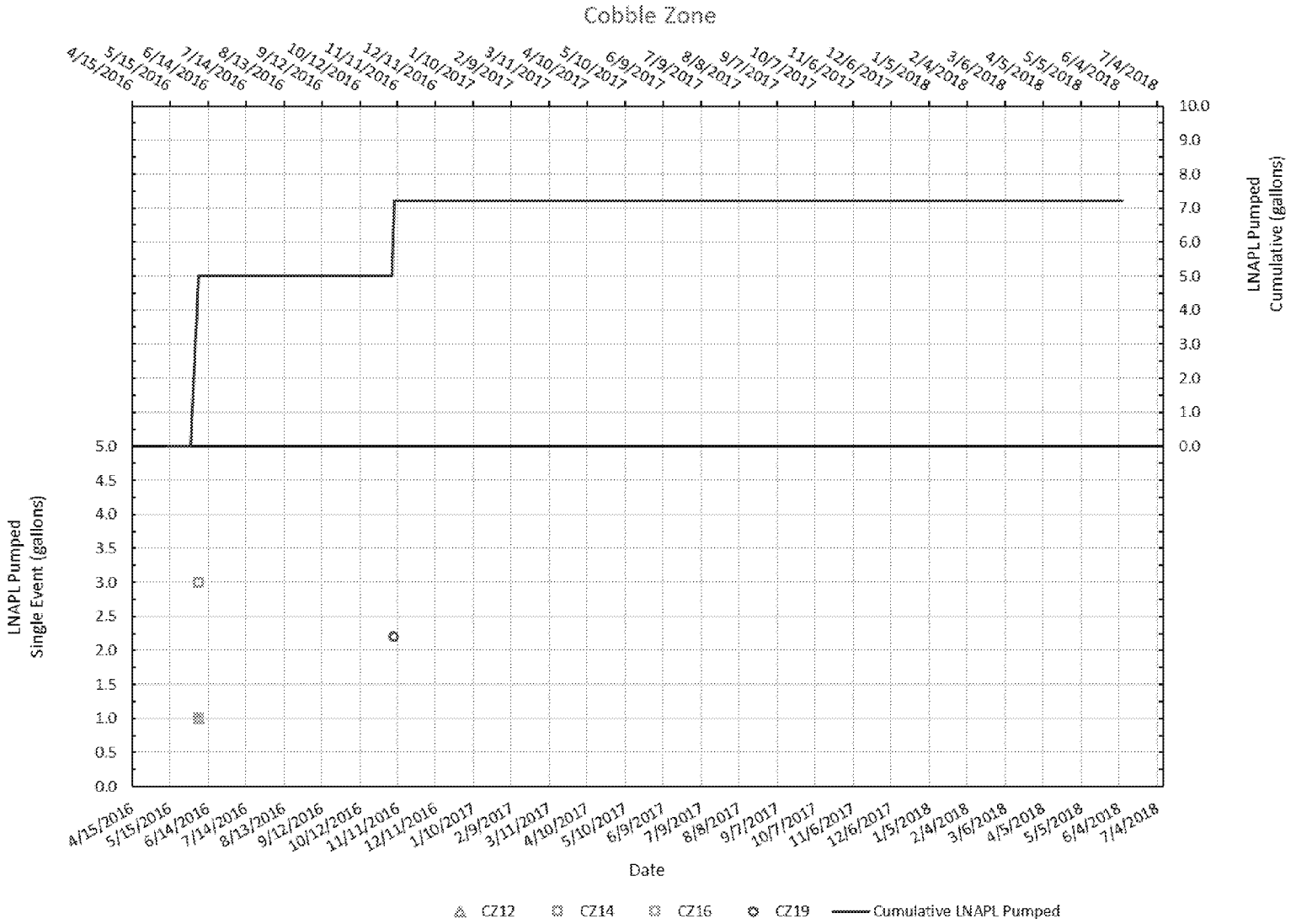
Estimated JP-4 degradation as methane is in addition to JP-4 removal reported for SVE

LNAPL Monitoring Update (through 8 Jun)

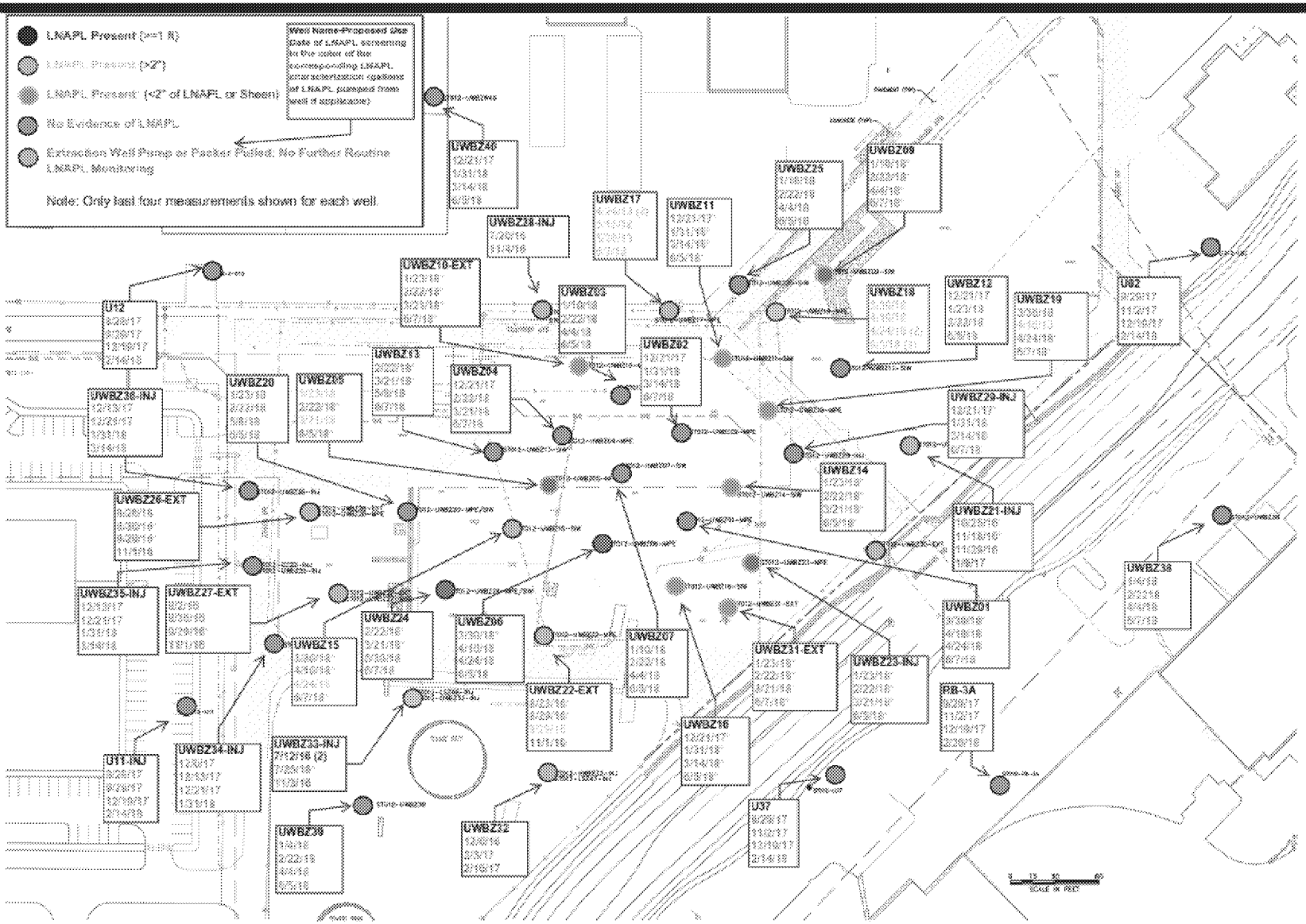
LNAPL Monitoring/Removal Status
Cobble Zone



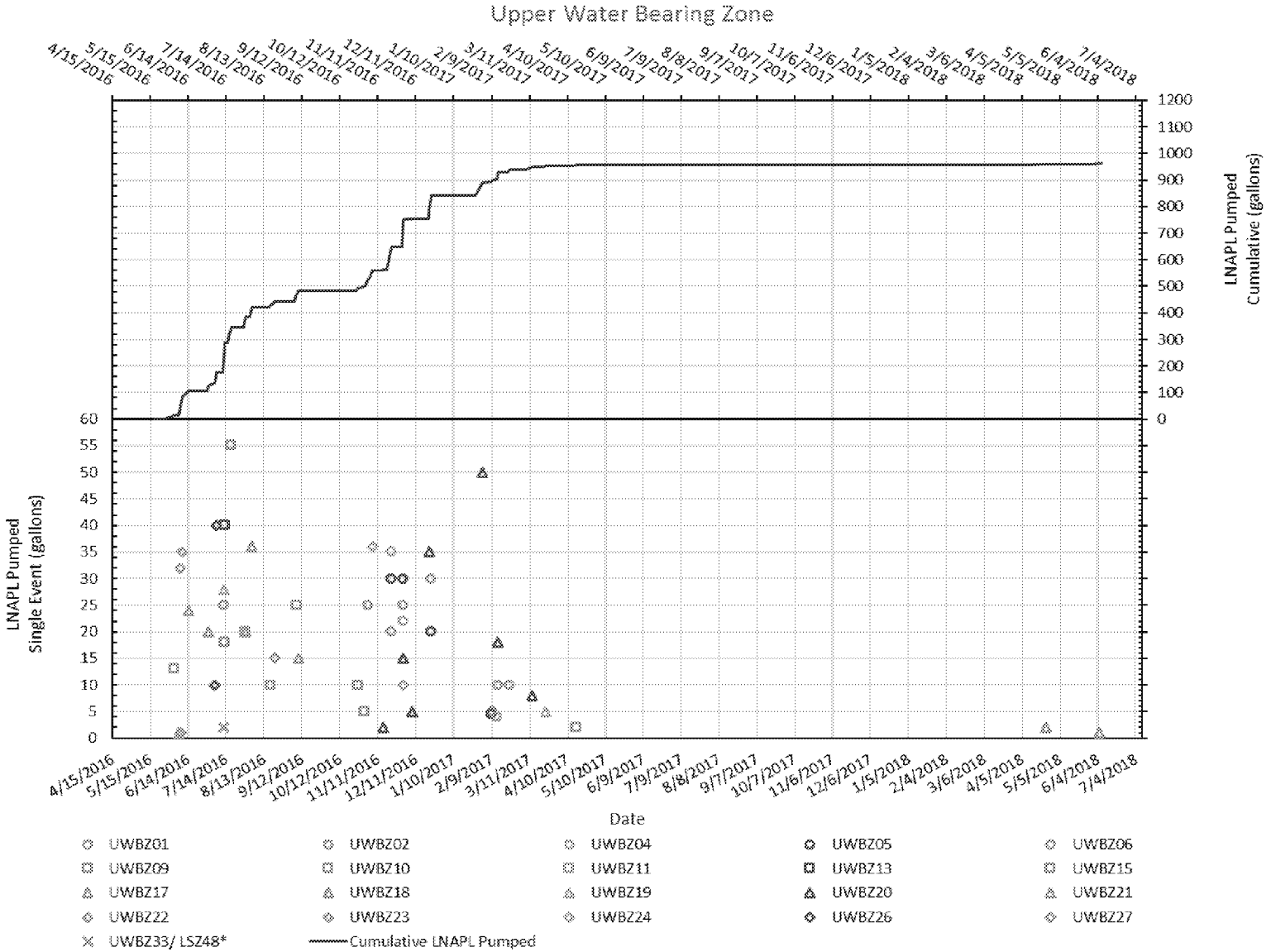
LNAPL Monitoring/Removal Status
Cobble Zone



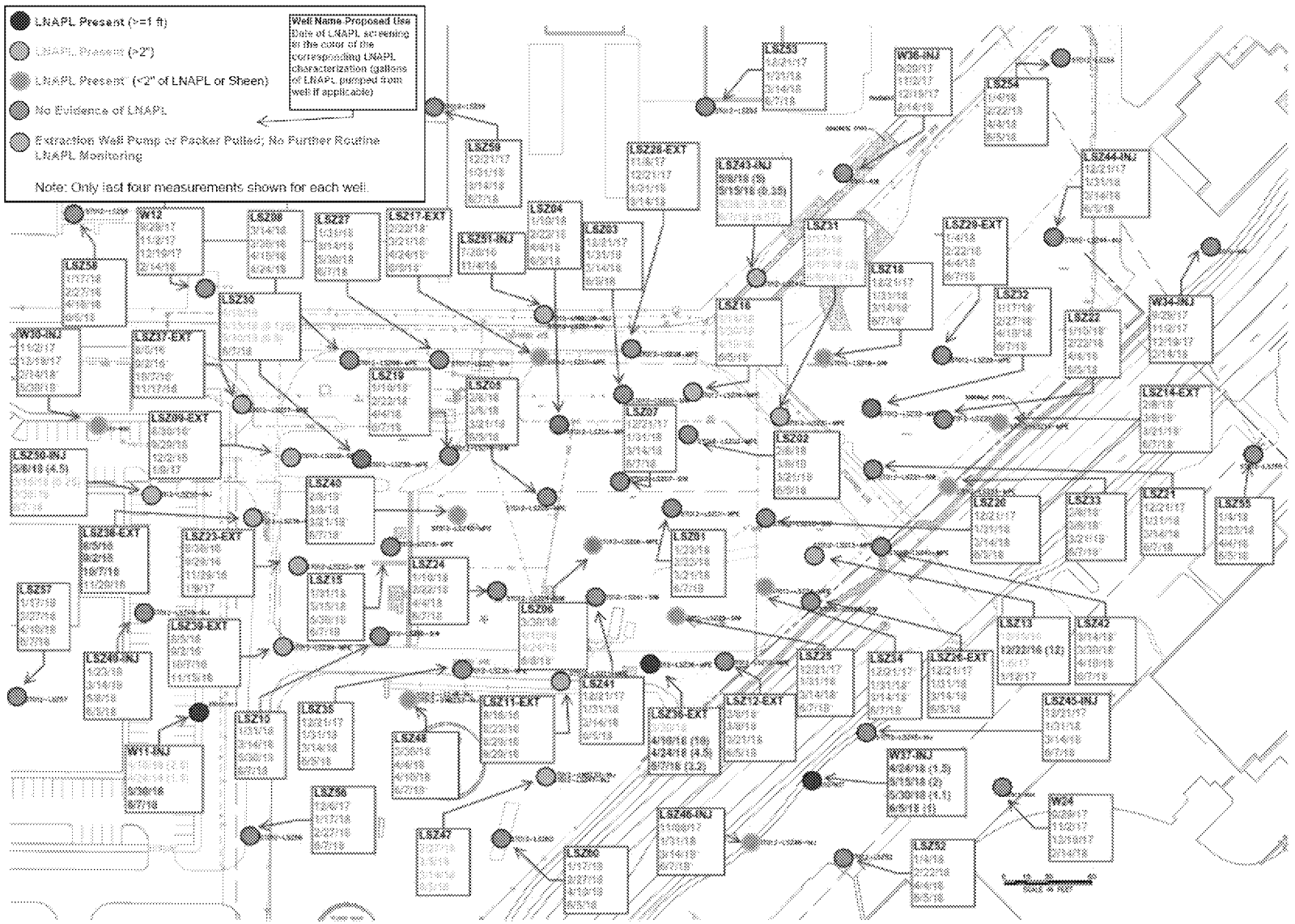
LNAPL Monitoring/Removal Status
Upper Water Bearing Zone



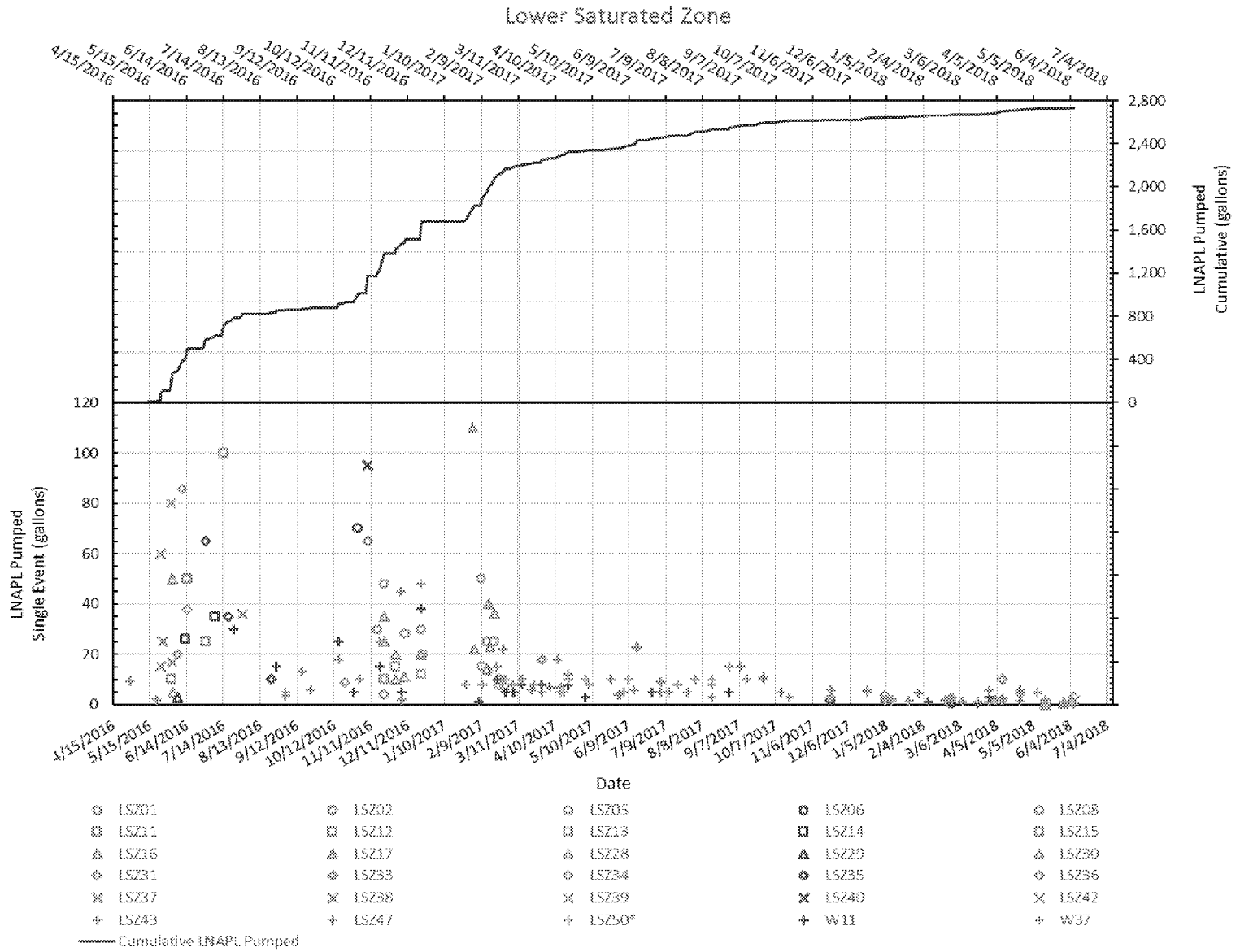
LNAPL Monitoring/Removal Status
Upper Water Bearing Zone



LNAPL Monitoring/Removal Status
Lower Saturated Zone



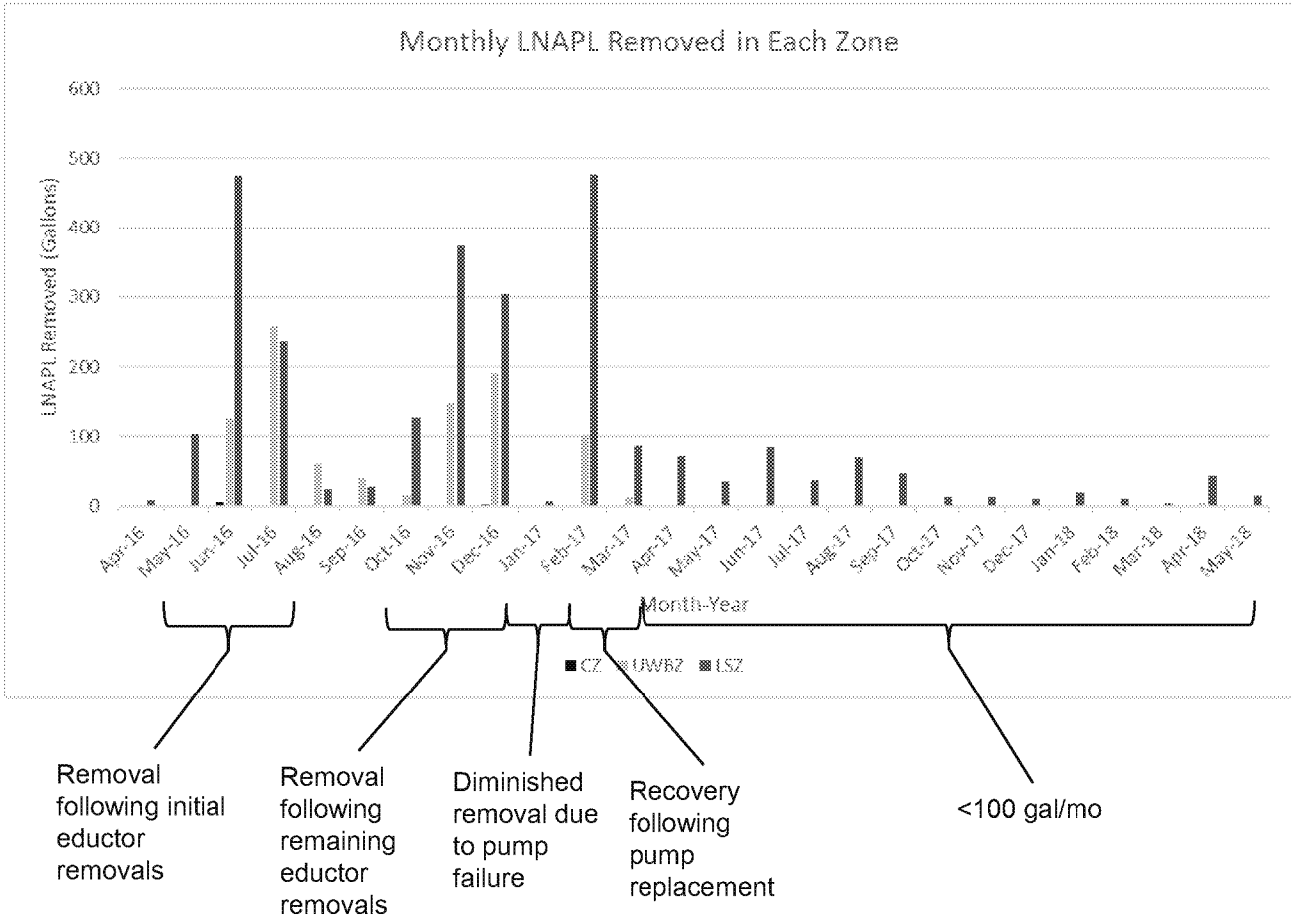
LNAPL Monitoring/Removal Status
Lower Saturated Zone



ST012 LNAPL Monitoring/Removal Summary

- **CZ – 7 gallons of LNAPL removed. None since Nov 2016**
- **UWBZ - 961 gallons of LNAPL removed. 1 gallon since May update (UWBZ18)**
- **LSZ - 2,734* gallons of LNAPL removed. 11* gallons removed since May update (W11, W37, LSZ30, LSZ31, LSZ36, LSZ43).**

***corrections to volumes removed at W37 and LSZ43 in April reduced LSZ total by 8 gallons from that reported in May BCT call**



Potential Migration Control Plan Outlined in Pilot Study Implementation Work Plan

Site ST012 Migration Control Plan Review

- **Pilot Study Implementation WP, Appendix J, Decision Matrix**

Decision Objective:	Other non-EBR performance criteria that may require action during active EBR		
Time Frame:	Any time during active EBR		
Criteria:			
Parameter	Desired Trend	Method	Discussion
LNAPL Accumulation	LNAPL accumulation remains low	field instrument	LNAPL removal is generally more efficient than EBR. LNAPL not removed can increase EBR timeframe.
VOC migration	VOCs don't migrate to perimeter wells	8260B	VOC migration would expand area requiring treatment
Sulfate migration	Sulfate doesn't significantly migrate outside of COC areas	field kit/9056A	Sulfate moving outside of COC impacted areas will not benefit EBR and can cause exceedance of the secondary MCL
Arsenic Concentrations	Arsenic concentrations do not exceed MCL	6010C	Arsenic in injection solution or naturally occurring arsenic liberated by reduced conditions might exceed MCLs
Biofouling	Biofouling does not hinder injections or sulfate distribution	field instrument	Significant changes in water levels or sustainable flow rates in the monitoring/injection/extraction wells with time may

Notes:
Parameters to be evaluated on an individual monitoring well basis for achievement of maximum transition criteria concentrations and on an overall average for average transition criteria.

	Condition	Action
Potential Contingencies:	1. LNAPL accumulates [illegible] site well	a. Remove LNAPL from well
	2. VOCs migrate to perimeter wells	a. Evaluate if sulfate migration with EBR may eventually address location. If yes, monitor
		b. Evaluate and implement extraction to prevent further migration
	3. Sulfate migrates outside COC areas	a. Depending on location and sulfate concentration, extract and reinject upgradient
	4. Arsenic exceeds MCL	a. Adjust injections (if arsenic measured in injection solution)
		b. Evaluate and implement extraction to prevent migration outside the active EBR area
	5. Biofouling in injection well	a. Pressurized injections
		b. Well redevelopment
	6. Biofouling in formation	a. Develop alternate sulfate injection/delivery for area of fouling

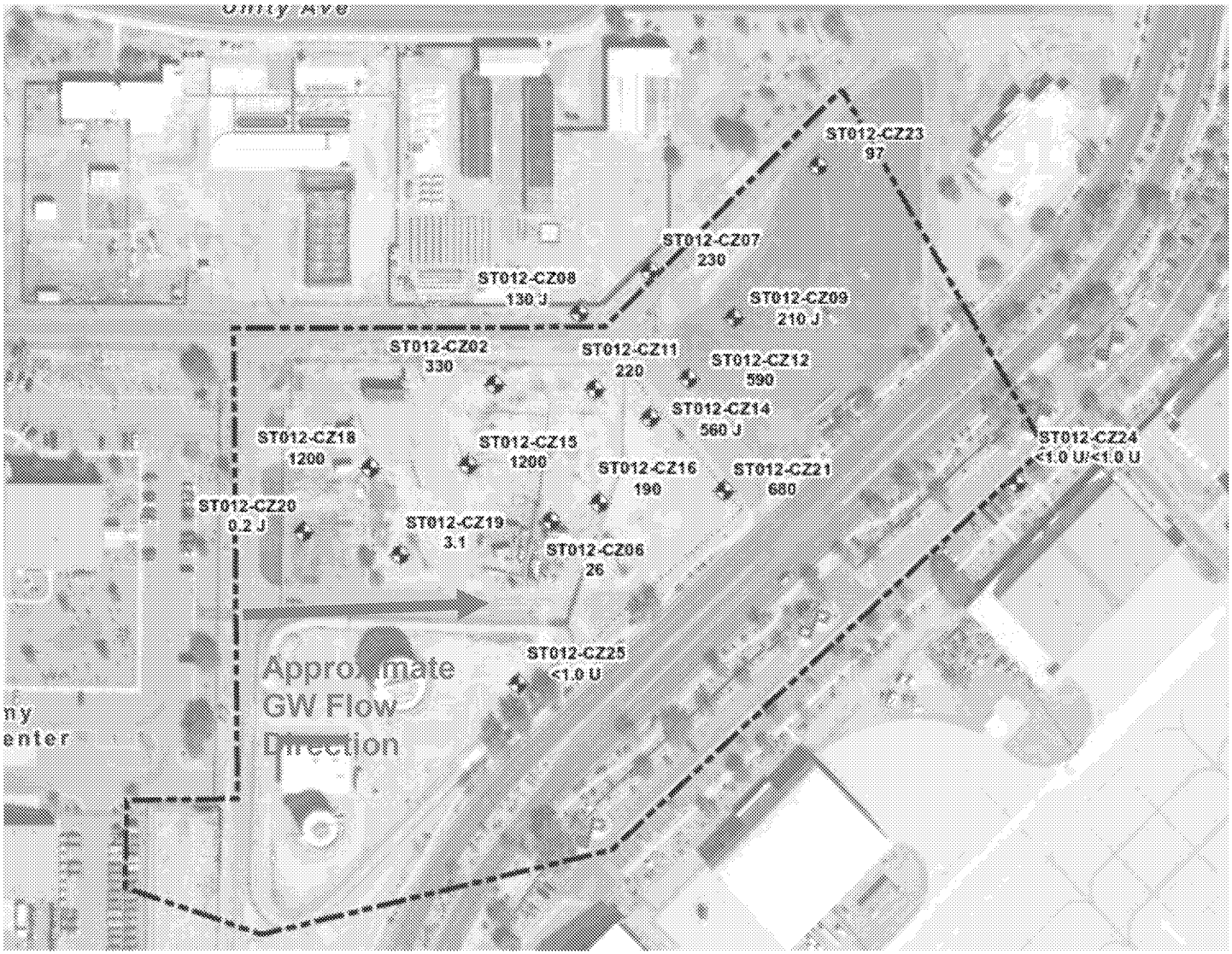
- **Potential migration control actions identified**
- **Flexibility intended to accommodate different situations**
- **Site specific actions will be developed**

Site ST012 Migration Control Applied at CZ23

- Sample collected on 10 April 2018
- Extraction in CZ07 started the week ending 4 May (intent to start CZ07 early to potentially free up the high temperature pump for use in other wells)
- Upon receipt and evaluation of the lab data indicating the result in CZ23, a transducer was deployed the week ending 18 May for evaluating hydraulic effects in CZ23 from the pumping at CZ07
- Water level readings collected on 29 May indicated a depth to water of 143.31 ft. This compares to a reading of 144.06 taken on 4 April 2018. Water table was lower by approximately 0.7 ft by extraction.
- Second VOC sample was collected in CZ23 on 4 June 2018. The preliminary quick turn result from Phoenix laboratory was 90 µg/L. Result from split sample to DOD-certified lab still pending.
- CZ07 was cycled on and off to further evaluate the hydraulic influence at CZ23. Transducer readings show a pumping response at CZ23.
- The water temperature at CZ07 has been in the low 150s °F. Electric submersible pump (which has a higher peak flow rate) installed this week.
- Extraction at CZ07 and monthly monitoring at CZ23 will continue

Preliminary Re-Baseline Groundwater Benzene Concentrations

Site ST012 CZ Re-Baseline
Benzene Groundwater Results (µg/L)



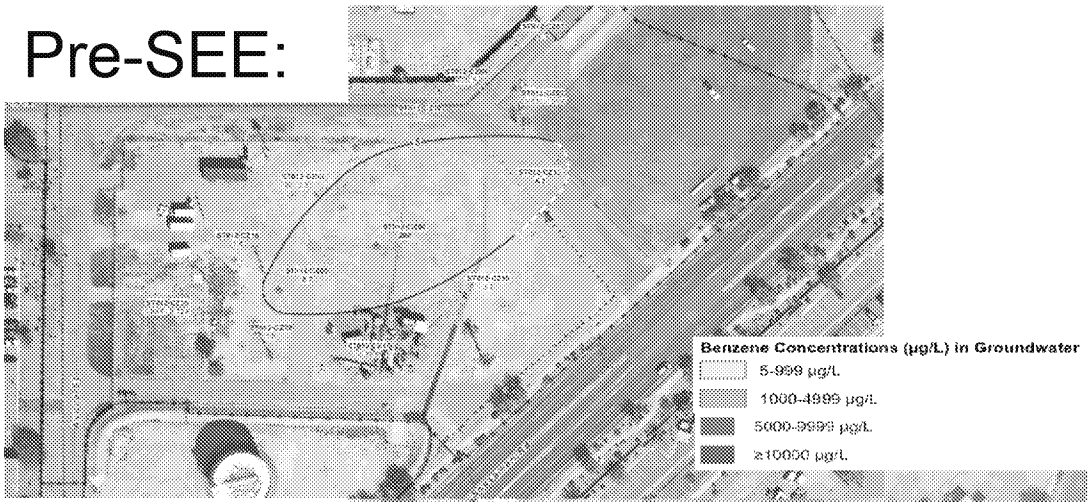
F - The analyte was detected, estimated above the MDL and below the RL.

J - The analyte was detected, estimated due to QC criteria.

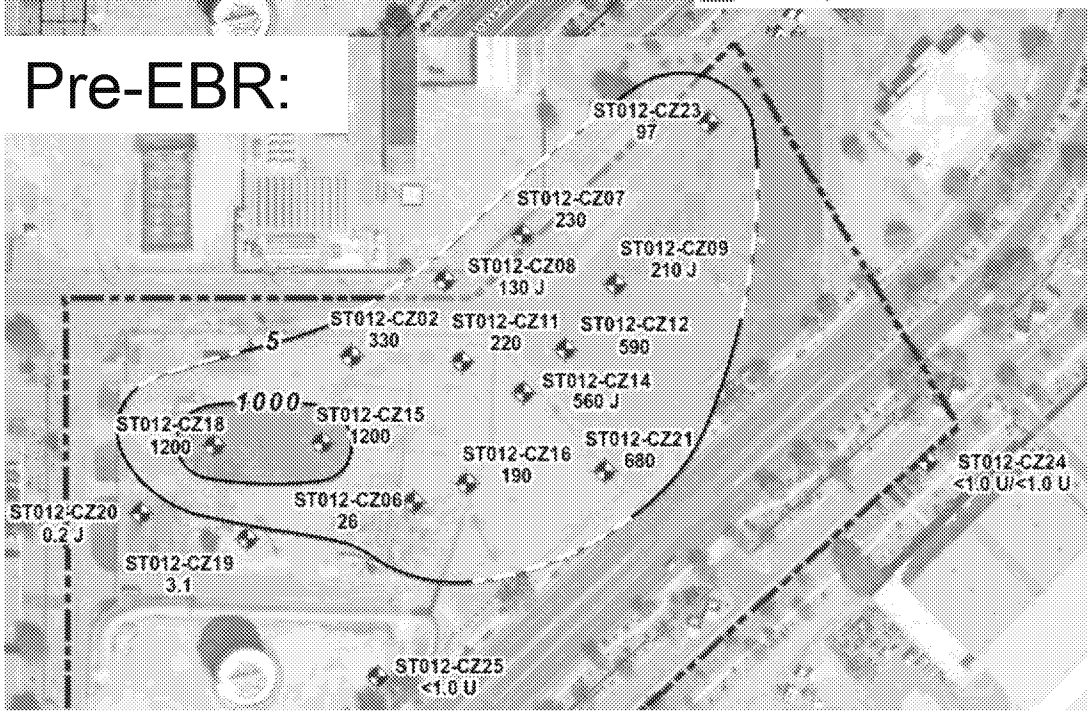
Site ST012 CZ Re-Baseline Benzene Concentration Observations

- **Maximum benzene increased from 260 µg/L pre-SEE to 1,200 µg/L (potentially due to vertical migration from UWBZ)**
- **Extent of benzene > MCLs increased from pre-SEE (potentially due to vertical migration from UWBZ)**
- **CZ is still the zone with lowest peak and average concentrations**

Pre-SEE:

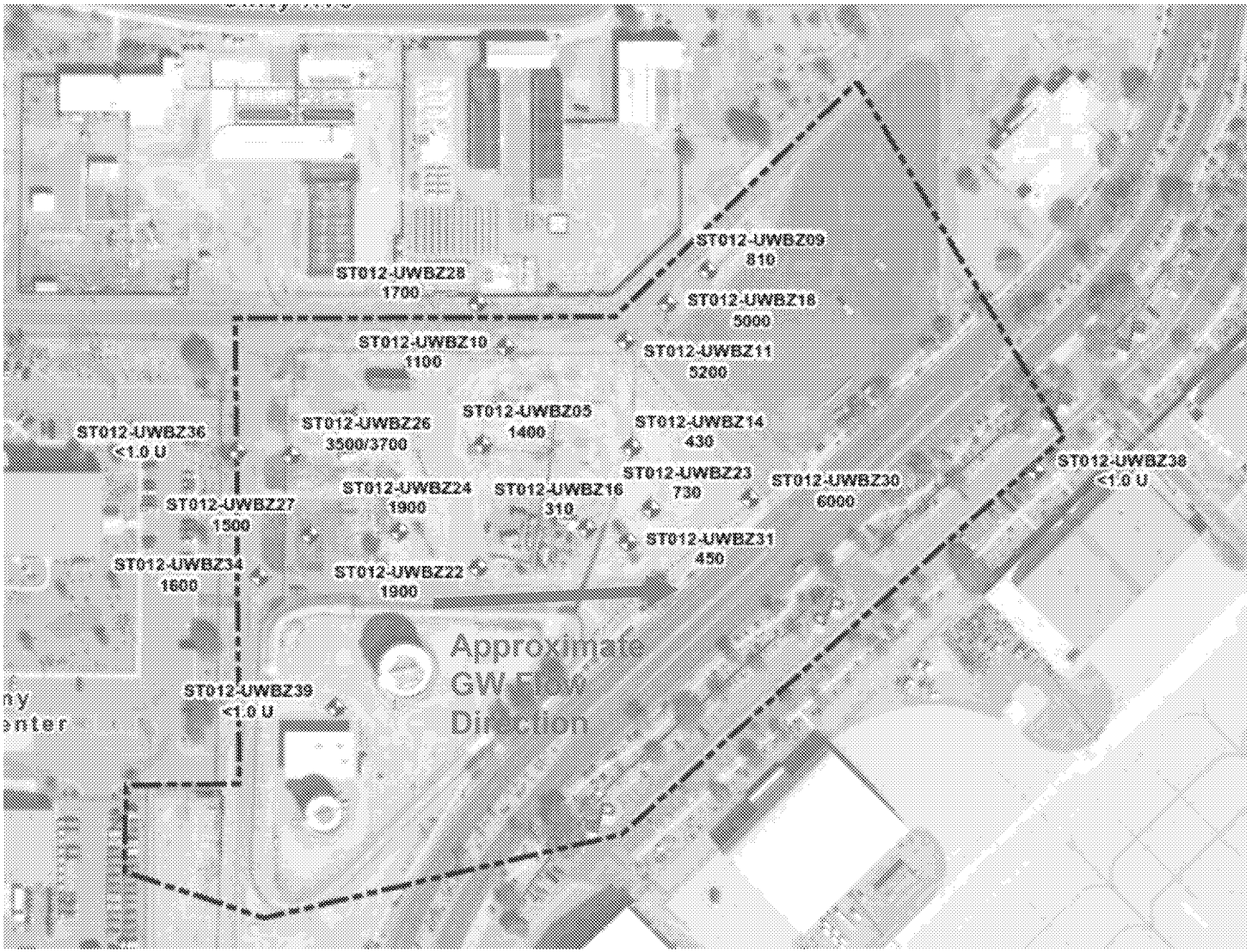


Pre-EBR:



27 June 2018

Site ST012 UWBZ Re-Baseline
Benzene Groundwater Results (µg/L)



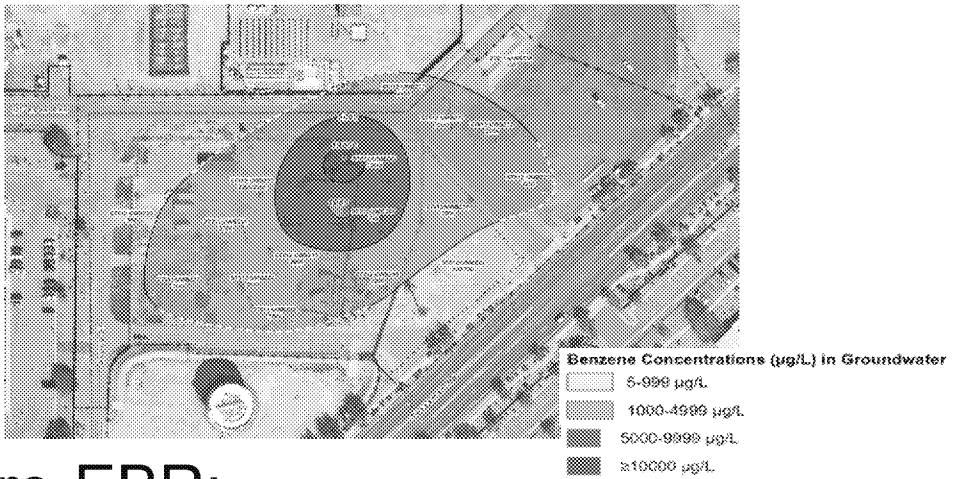
F - The analyte was detected, estimated above the MDL and below the RL.

J - The analyte was detected, estimated due to QC criteria.

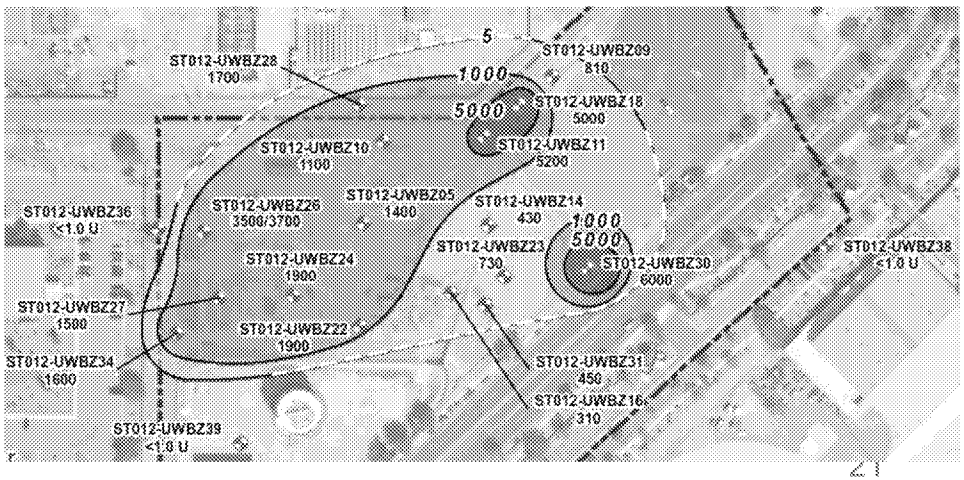
Site ST012 UWBZ Re-Baseline Benzene Concentration Observations

- **5-1,000 µg/L contour not defined pre-SEE**
- **Peak concentration reduced from 12,000 µg/L pre-SEE to 5,200 µg/L in SEE treatment area**
- **Additional 6,000 µg/L area outside SEE treatment identified at UWBZ30**
- **Similar 1,000-5,000 µg/L contour pre and post-SEE**

Pre-SEE:



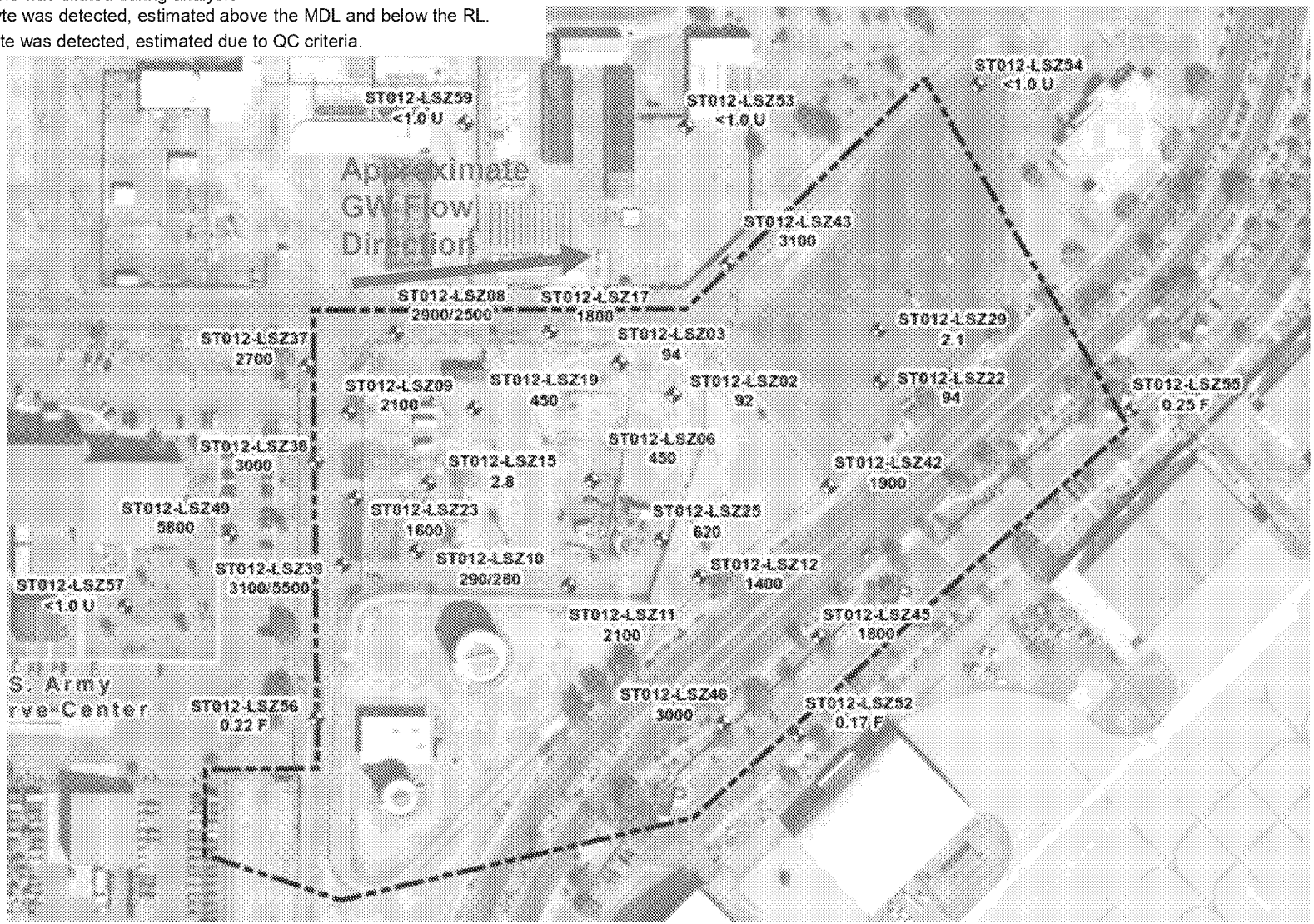
Pre-EBR:



27 June 2018

Site ST012 LSZ Re-Baseline
Benzene Groundwater Results (µg/L)

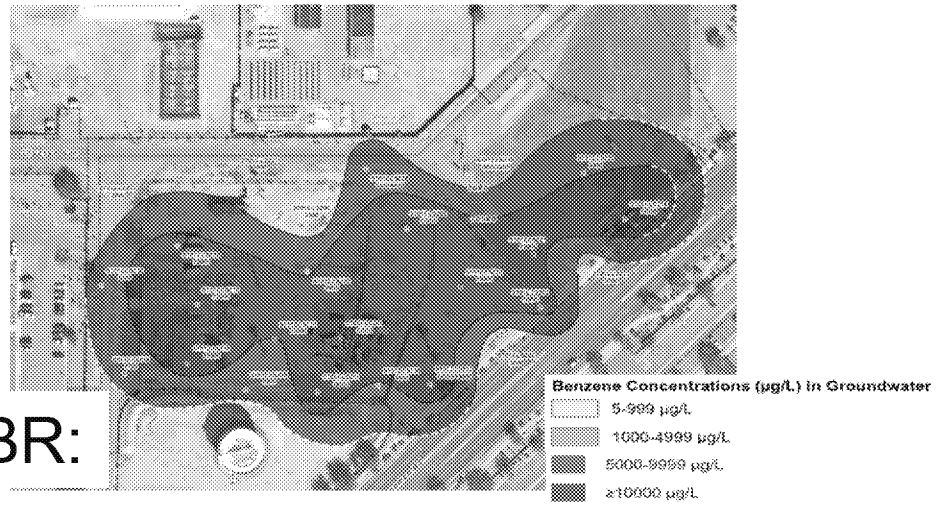
D – The sample was diluted during analysis
F – The analyte was detected, estimated above the MDL and below the RL.
J – The analyte was detected, estimated due to QC criteria.



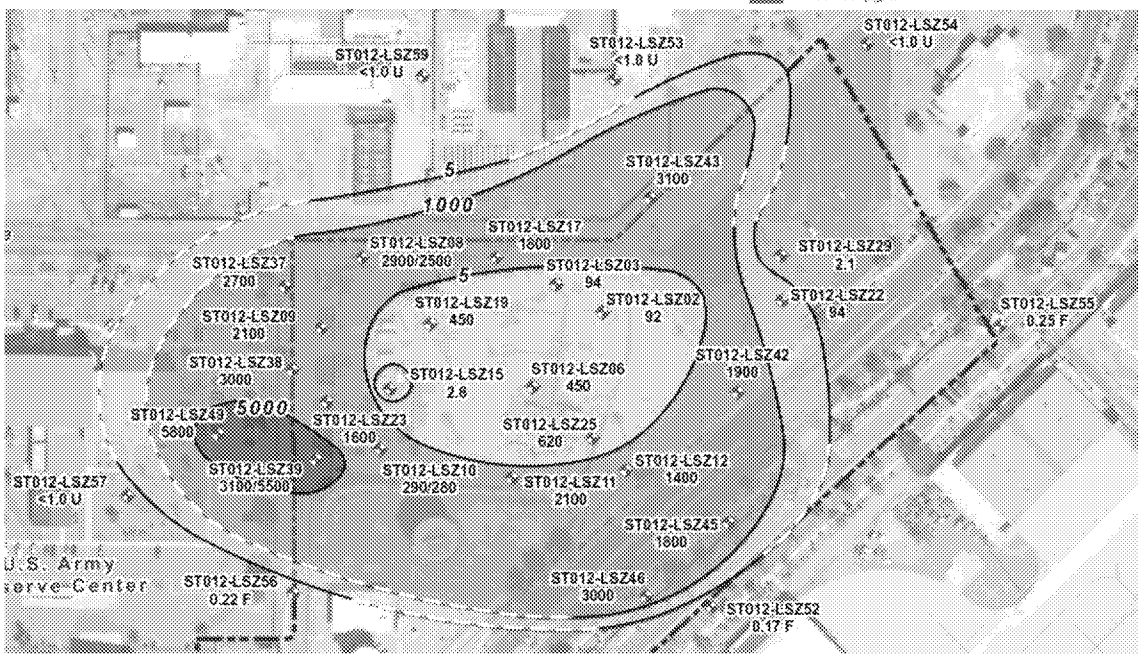
Site ST012 LSZ Re-Baseline Benzene Concentration Observations

- **Pre-SEE data contoured >5,000 µg/L concentrations**
- **Peak concentrations reduced from many >10,000 pre-SEE to two wells >5,000**
- **Reduced benzene concentrations in center of site**

Pre-SEE:



Pre-EBR:



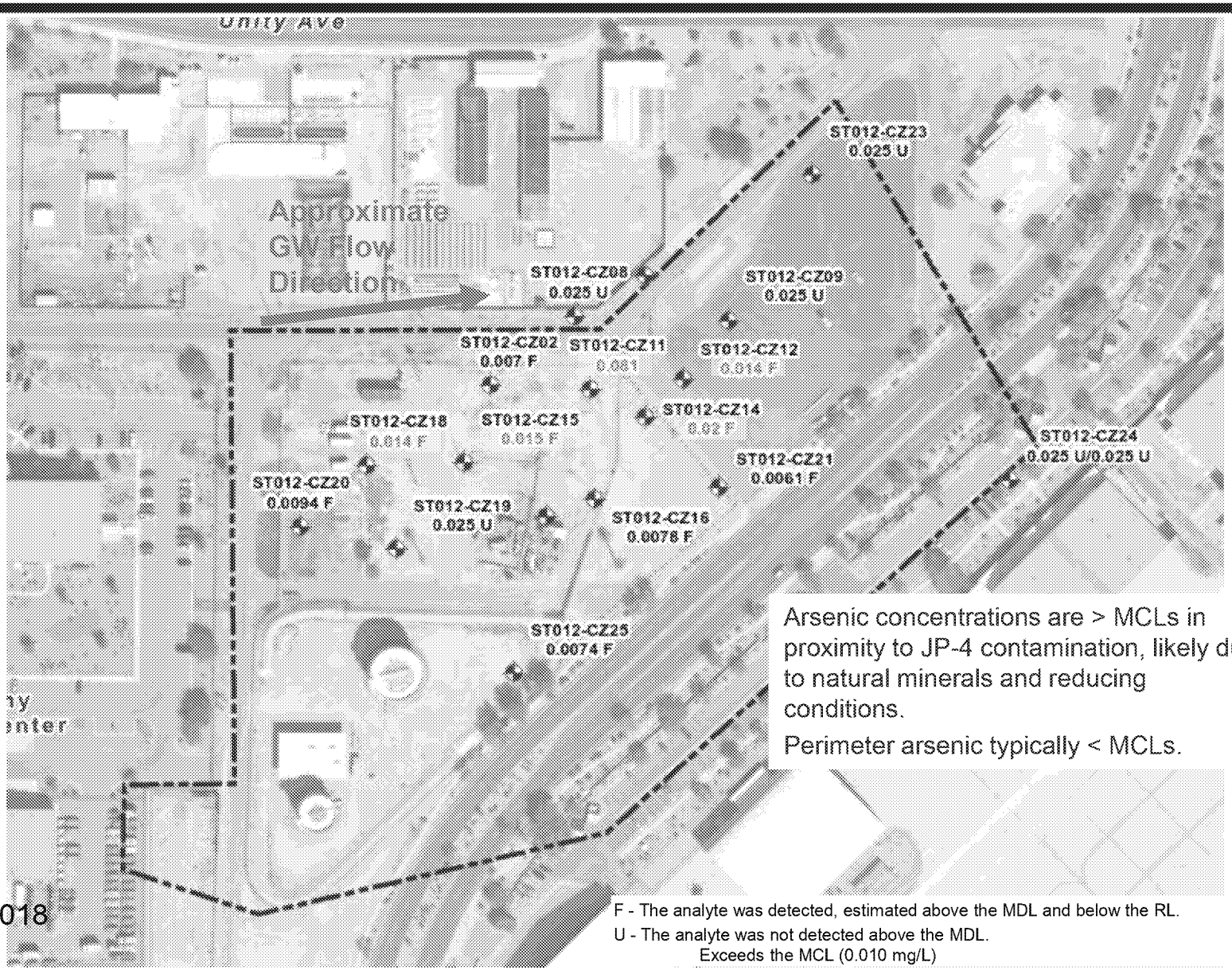
27 June 2018

Preliminary Re-Baseline Groundwater Arsenic Concentrations

Site ST012 Re-Baseline Arsenic Results

- **Re-Baseline results indicate that in all three zones (CZ, UWBZ, and LSZ)**
  - **Arsenic concentrations are greater than MCLs in proximity to elevated petroleum hydrocarbon contamination. This condition is likely due to existing natural minerals that are biologically transformed under reduced redox conditions.**
  - **Perimeter arsenic concentrations are typically less than MCLs when low or no hydrocarbon contamination is present.**
  - **Please note that although the arsenic reporting limit (RL) is 0.025 mg/L which is above the arsenic MCL of 0.01 mg/L, the arsenic results that are flagged with a U indicates that no arsenic was detected above the method detection limit (MDL) which is below the arsenic MCL. An arsenic result flagged with an F indicate that arsenic was detected between the RL and MDL but is an estimated value (i.e. not quantifiable)**

Site ST012 CZ Re-Baseline
Arsenic Groundwater Results (mg/L)



Arsenic concentrations are > MCLs in proximity to JP-4 contamination, likely due to natural minerals and reducing conditions.

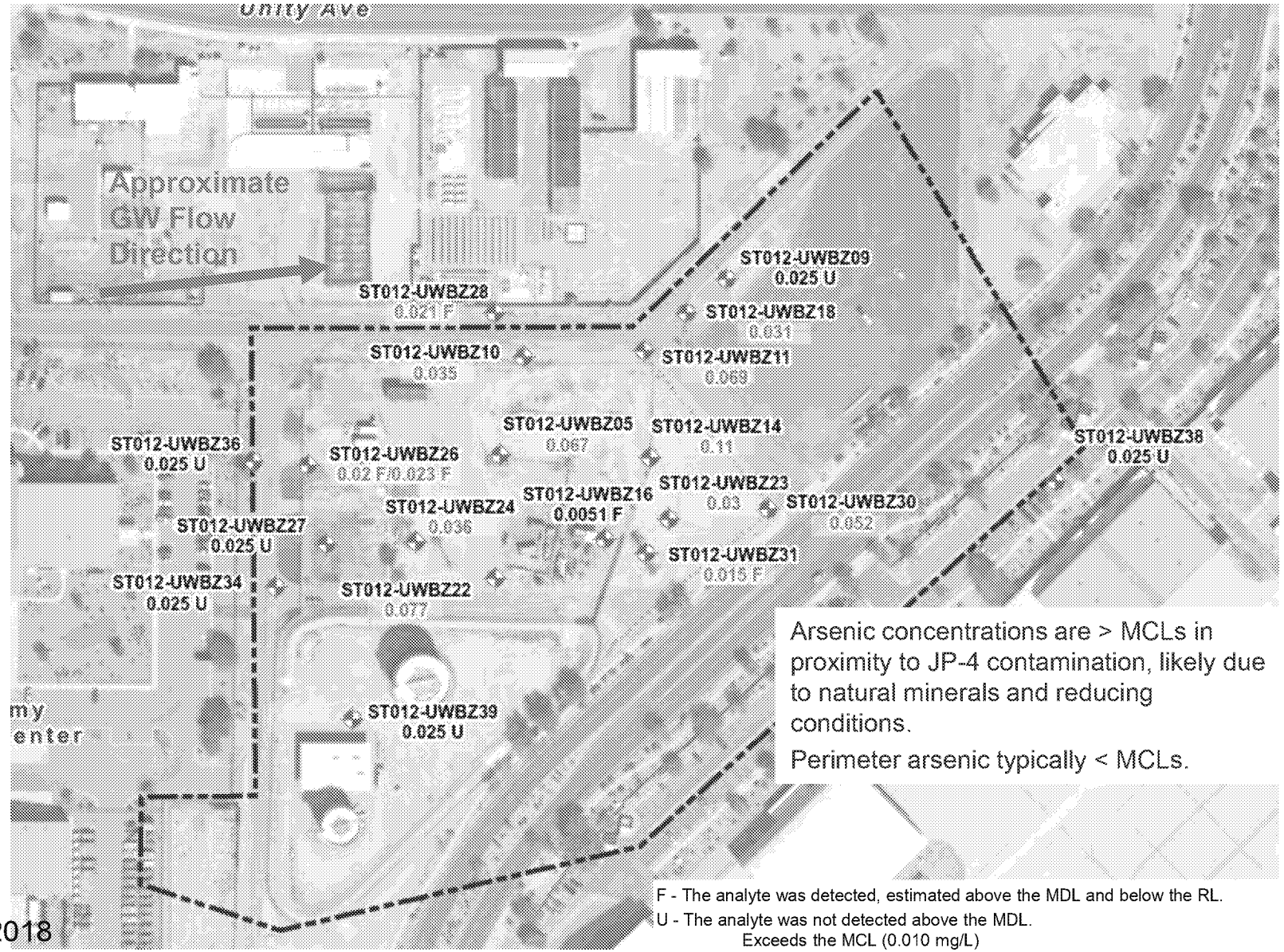
Perimeter arsenic typically < MCLs.

F - The analyte was detected, estimated above the MDL and below the RL.

U - The analyte was not detected above the MDL.

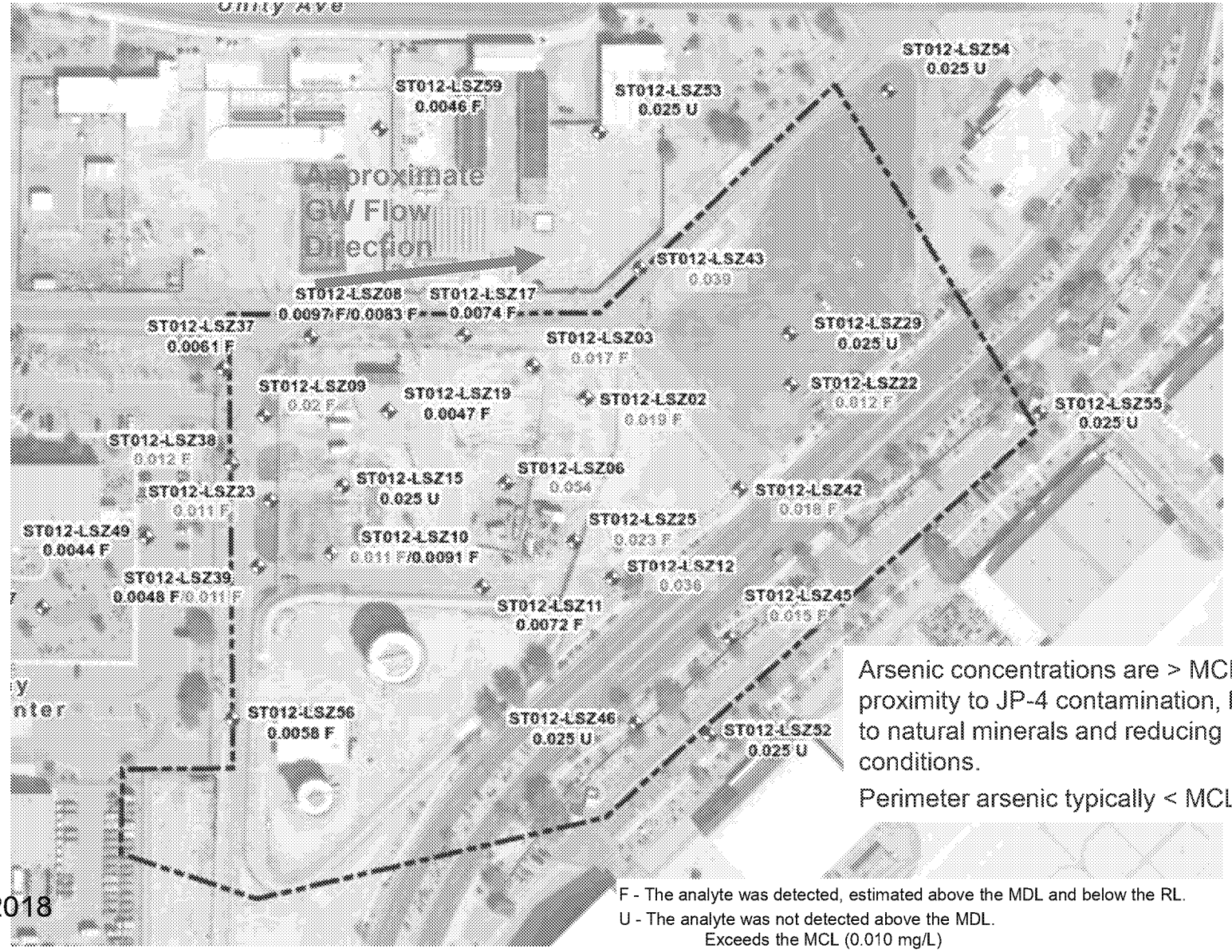
Exceeds the MCL (0.010 mg/L)

Site ST012 UWBZ Re-Baseline Arsenic Groundwater Results (mg/L)



F - The analyte was detected, estimated above the MDL and below the RL.
U - The analyte was not detected above the MDL.
Exceeds the MCL (0.010 mg/L)

Site ST012 LSZ Re-Baseline
Arsenic Groundwater Results (mg/L)



Arsenic concentrations are > MCLs in proximity to JP-4 contamination, likely due to natural minerals and reducing conditions.

Perimeter arsenic typically < MCLs.

F - The analyte was detected, estimated above the MDL and below the RL.

U - The analyte was not detected above the MDL.

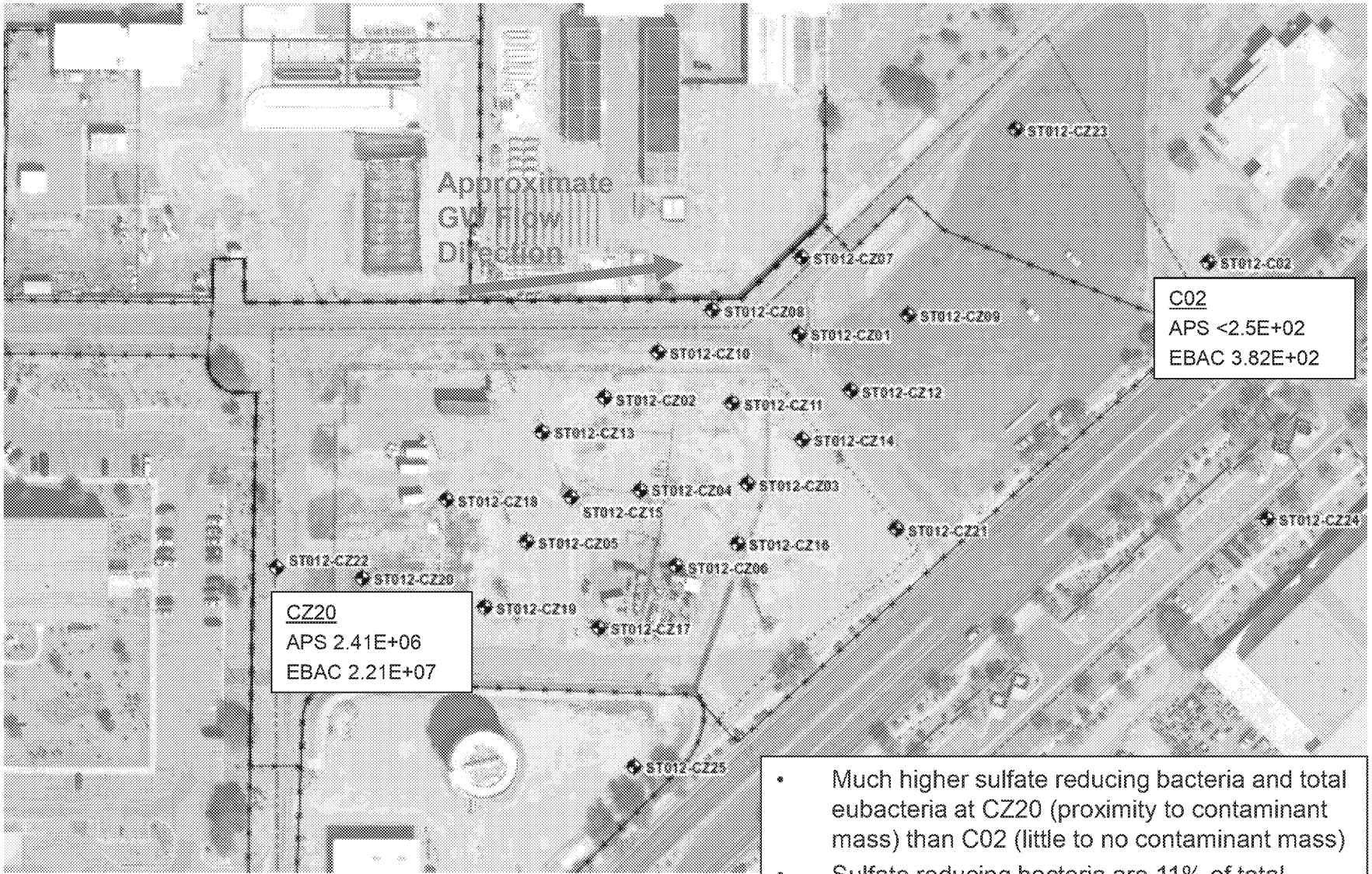
Exceeds the MCL (0.010 mg/L)

Preliminary Re-baseline Microbial Analysis

Site ST012 Re-Baseline Microbial

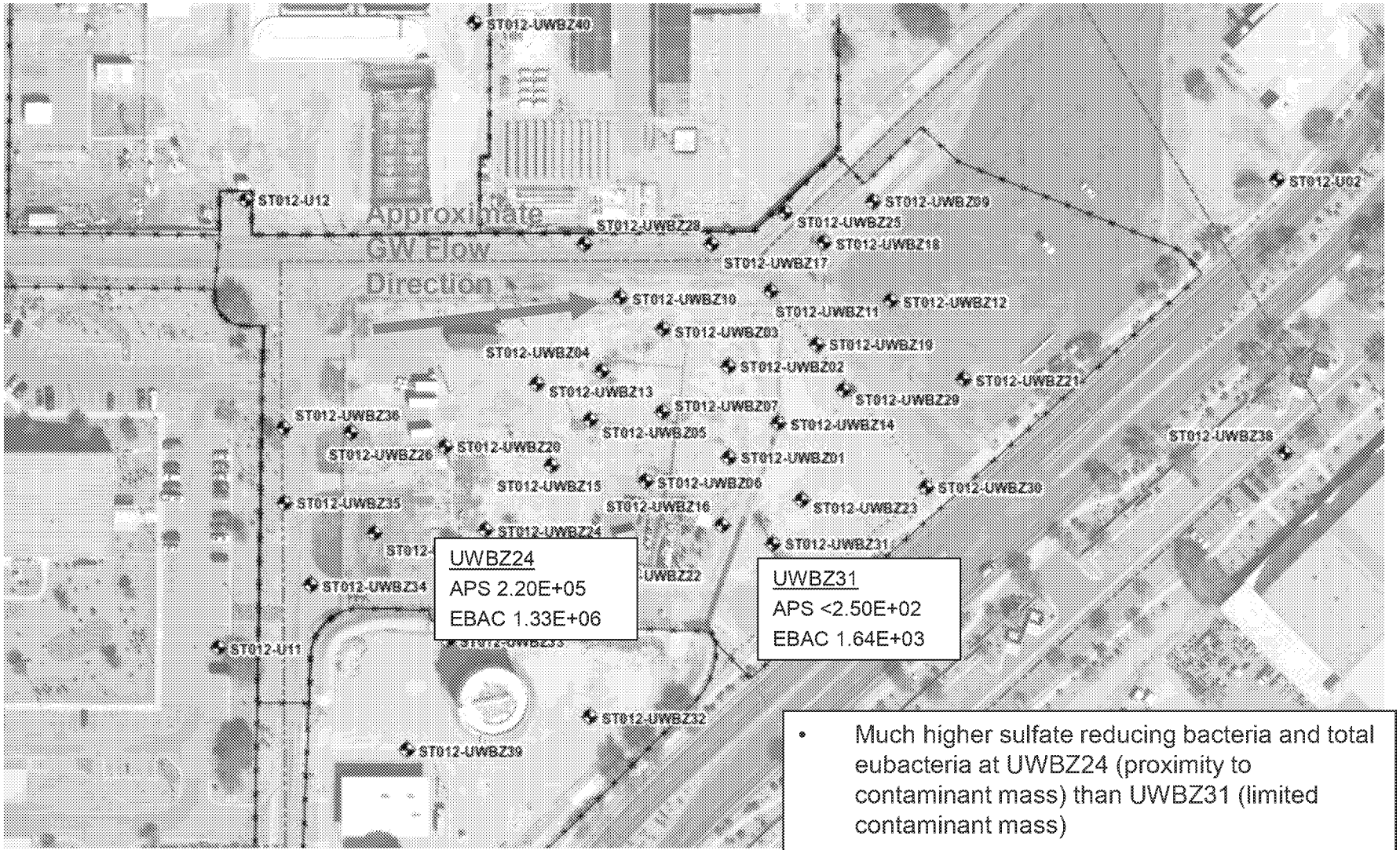
- **Bio-Traps placed in six wells**
  - Two in each zone (CZ, UWBZ, LSZ)
- **qPCR analysis for**
  - APS – Sulfate Reducing Bacteria
  - EBAC – total Eubacteria
- **Re-Baseline results indicate**
  - Significantly higher sulfate reducing bacteria and total eubacteria at proximity to high contaminant mass as compared to areas of little to no contaminant mass in all three zones
  - Sulfate reducing bacteria range from 11% to 43% of total eubacteria in locations with high contaminate mass

Site ST012 CZ
qPCR Results (cells/bead)



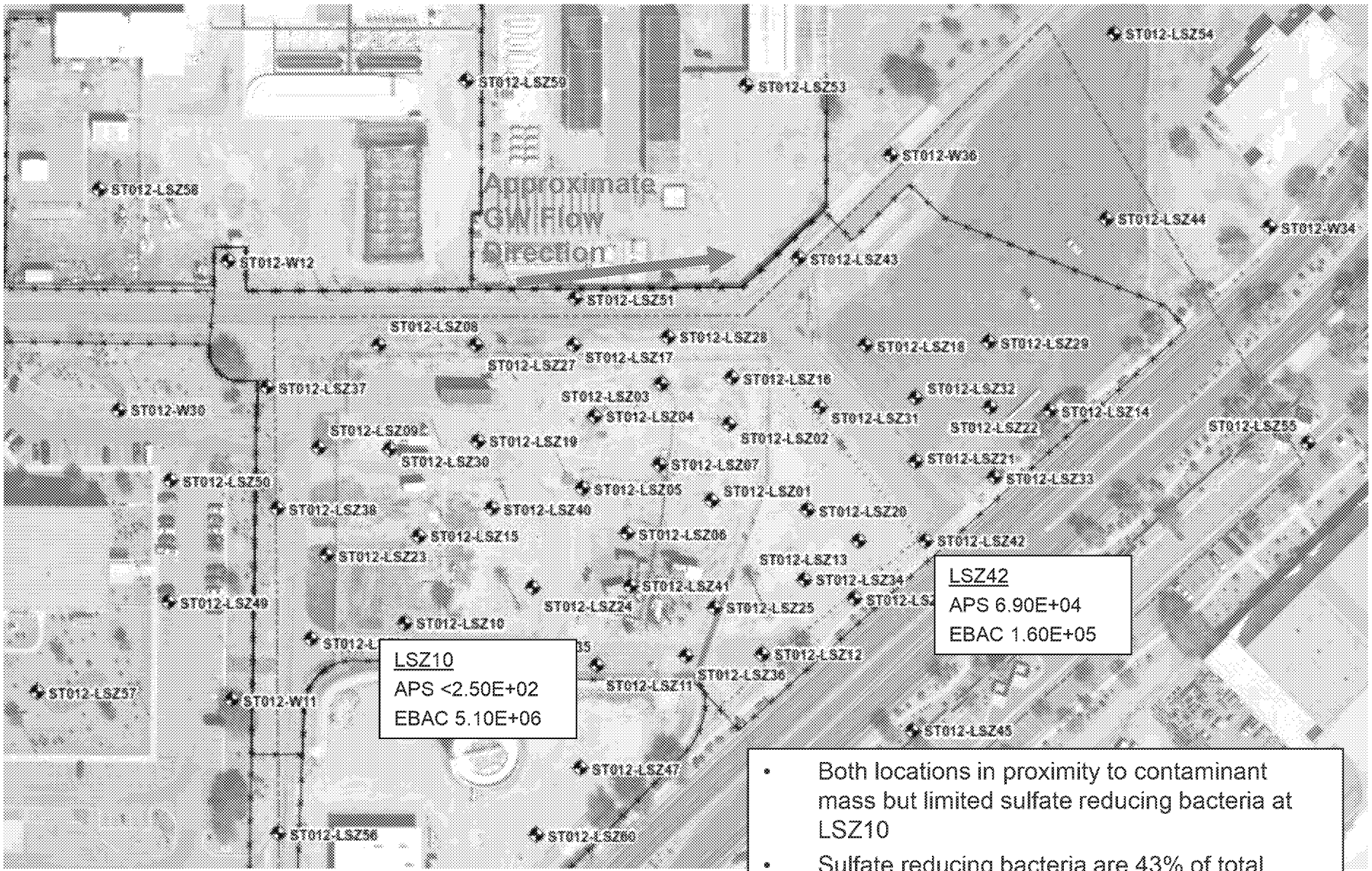
- Much higher sulfate reducing bacteria and total eubacteria at CZ20 (proximity to contaminant mass) than C02 (little to no contaminant mass)
- Sulfate reducing bacteria are 11% of total eubacteria at CZ20

Site ST012 UWBZ qPCR Results (cell/bead)



- Much higher sulfate reducing bacteria and total eubacteria at UWBZ24 (proximity to contaminant mass) than UWBZ31 (limited contaminant mass)
- Sulfate reducing bacteria are 16.5% of total eubacteria at UWBZ24

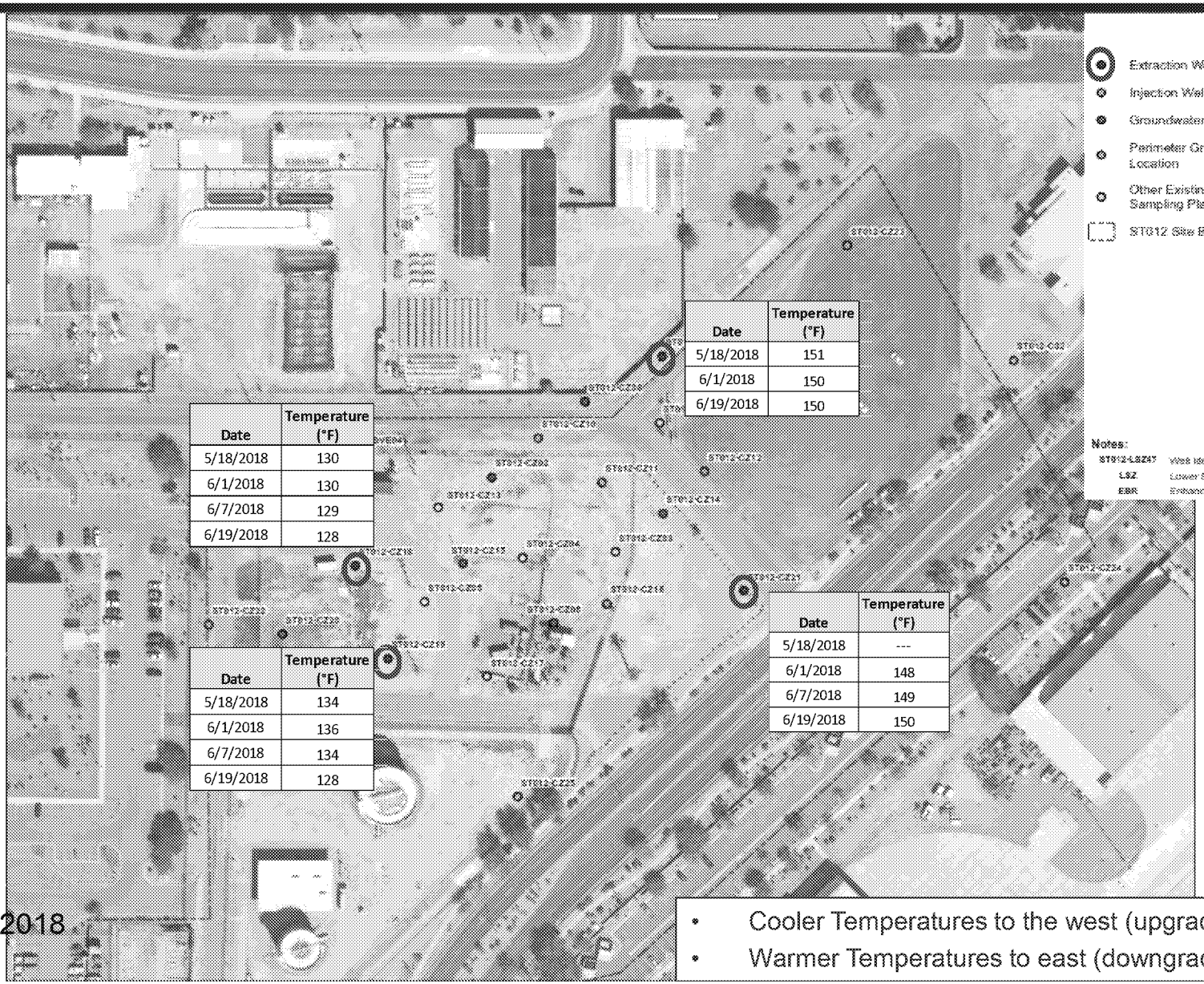
Site ST012 LSZ qPCR Results (cells/bead)



- Both locations in proximity to contaminant mass but limited sulfate reducing bacteria at LSZ10
- Sulfate reducing bacteria are 43% of total eubacteria at LSZ42

Extraction Well Temperatures

Site ST012 CZ
Extraction Locations and Temperatures



Date	Temperature (°F)
5/18/2018	151
6/1/2018	150
6/19/2018	150

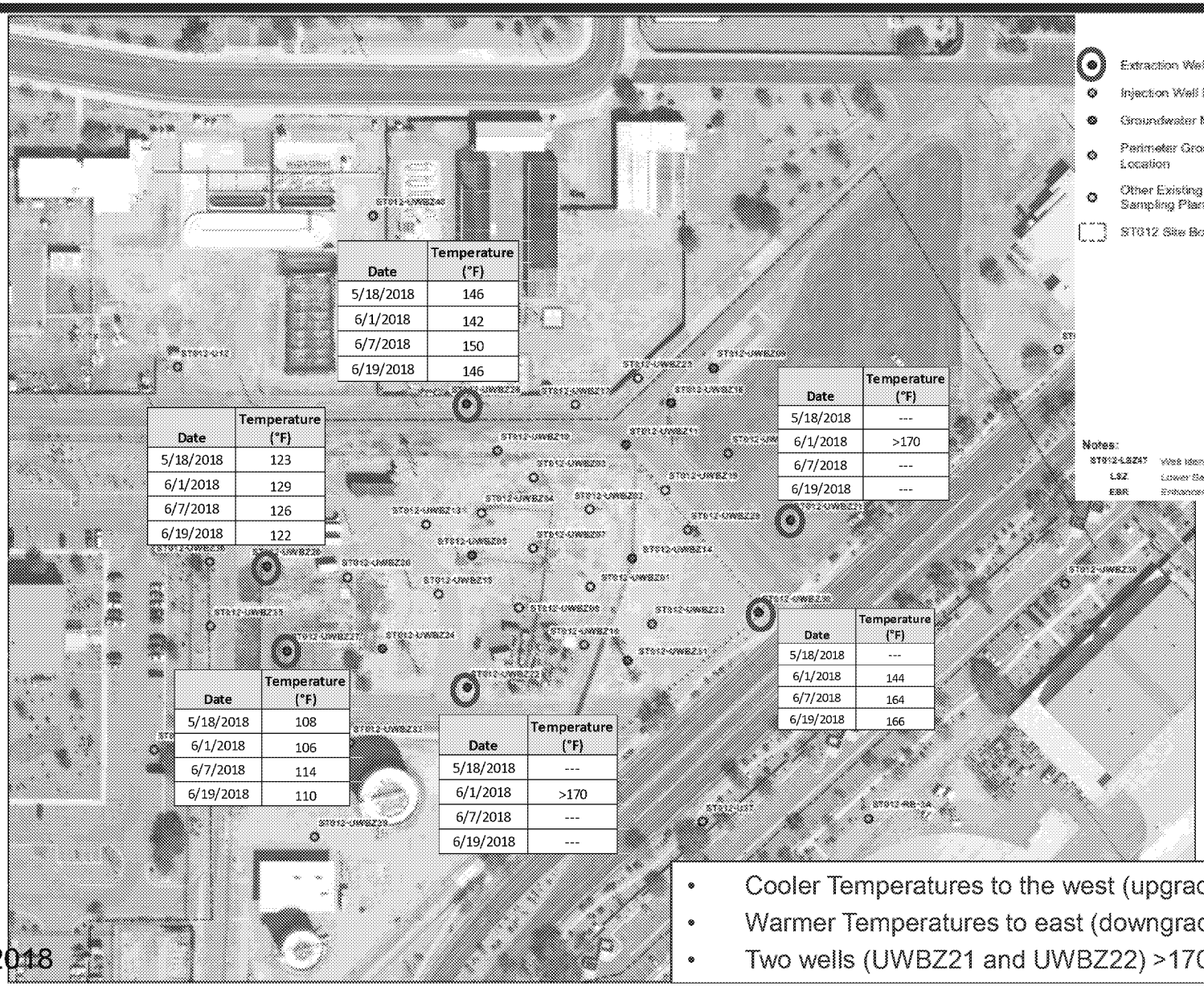
Date	Temperature (°F)
5/18/2018	130
6/1/2018	130
6/7/2018	129
6/19/2018	128

Date	Temperature (°F)
5/18/2018	---
6/1/2018	148
6/7/2018	149
6/19/2018	150

Date	Temperature (°F)
5/18/2018	134
6/1/2018	136
6/7/2018	134
6/19/2018	128

- Cooler Temperatures to the west (upgradient)
- Warmer Temperatures to east (downgradient)

Site ST012 UWBZ Extraction Locations and Temperatures



Date	Temperature (°F)
5/18/2018	146
6/1/2018	142
6/7/2018	150
6/19/2018	146

Date	Temperature (°F)
5/18/2018	123
6/1/2018	129
6/7/2018	126
6/19/2018	122

Date	Temperature (°F)
5/18/2018	---
6/1/2018	>170
6/7/2018	---
6/19/2018	---

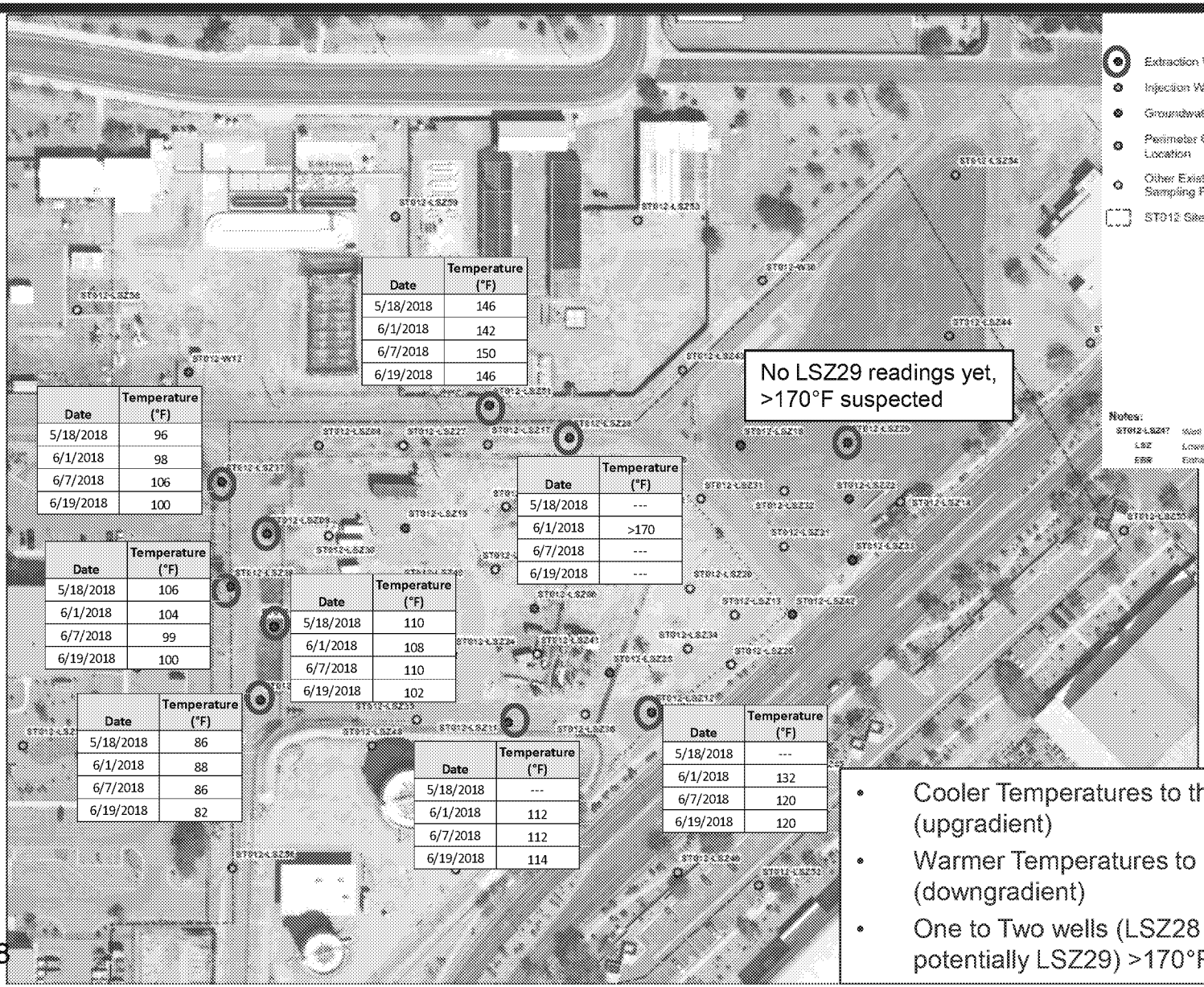
Date	Temperature (°F)
5/18/2018	108
6/1/2018	106
6/7/2018	114
6/19/2018	110

Date	Temperature (°F)
5/18/2018	---
6/1/2018	>170
6/7/2018	---
6/19/2018	---

Date	Temperature (°F)
5/18/2018	---
6/1/2018	144
6/7/2018	164
6/19/2018	166

- Cooler Temperatures to the west (upgradient)
- Warmer Temperatures to east (downgradient)
- Two wells (UWBZ21 and UWBZ22) >170°F

Site ST012 LSZ Extraction Locations and Temperatures



Date	Temperature (°F)
5/18/2018	146
6/1/2018	142
6/7/2018	150
6/19/2018	146

No LSZ29 readings yet, >170°F suspected

Date	Temperature (°F)
5/18/2018	96
6/1/2018	98
6/7/2018	106
6/19/2018	100

Date	Temperature (°F)
5/18/2018	---
6/1/2018	>170
6/7/2018	---
6/19/2018	---

Date	Temperature (°F)
5/18/2018	106
6/1/2018	104
6/7/2018	99
6/19/2018	100

Date	Temperature (°F)
5/18/2018	110
6/1/2018	108
6/7/2018	110
6/19/2018	102

Date	Temperature (°F)
5/18/2018	86
6/1/2018	88
6/7/2018	86
6/19/2018	82

Date	Temperature (°F)
5/18/2018	---
6/1/2018	112
6/7/2018	112
6/19/2018	114

Date	Temperature (°F)
5/18/2018	---
6/1/2018	132
6/7/2018	120
6/19/2018	120

- Cooler Temperatures to the west (upgradient)
- Warmer Temperatures to northeast (downgradient)
- One to Two wells (LSZ28 and potentially LSZ29) >170°F

Re-baseline Interpretation and Injection Plan Adjustments

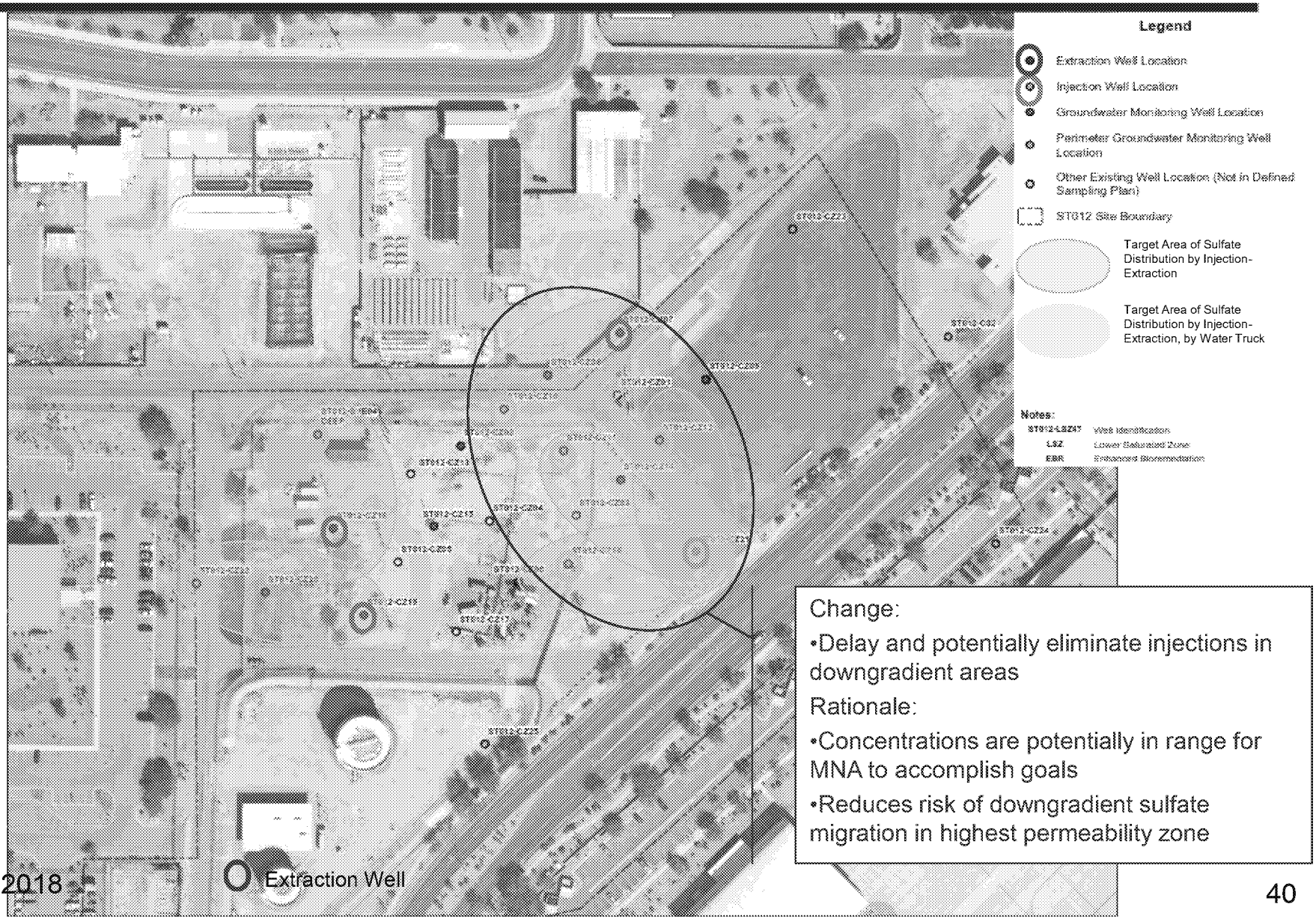
Site ST012 Injection Plan Adjustments

- **CZ**
  - **Delay and potentially eliminate injections in downgradient areas**

  Rationale:
  - **Concentrations are in range for MNA to accomplish goals**
  - **Reduces risk of downgradient sulfate migration in highest permeability zone**

- **Extraction at CZ07 will continue to provide migration control at CZ23**

Site ST012
CZ Locations and Sequences



Change:

- Delay and potentially eliminate injections in downgradient areas

Rationale:

- Concentrations are potentially in range for MNA to accomplish goals
- Reduces risk of downgradient sulfate migration in highest permeability zone

Site ST012 Injection Plan Adjustments

- **UWBZ**
  - **No Changes**

Site ST012
UWBZ Locations and Sequences

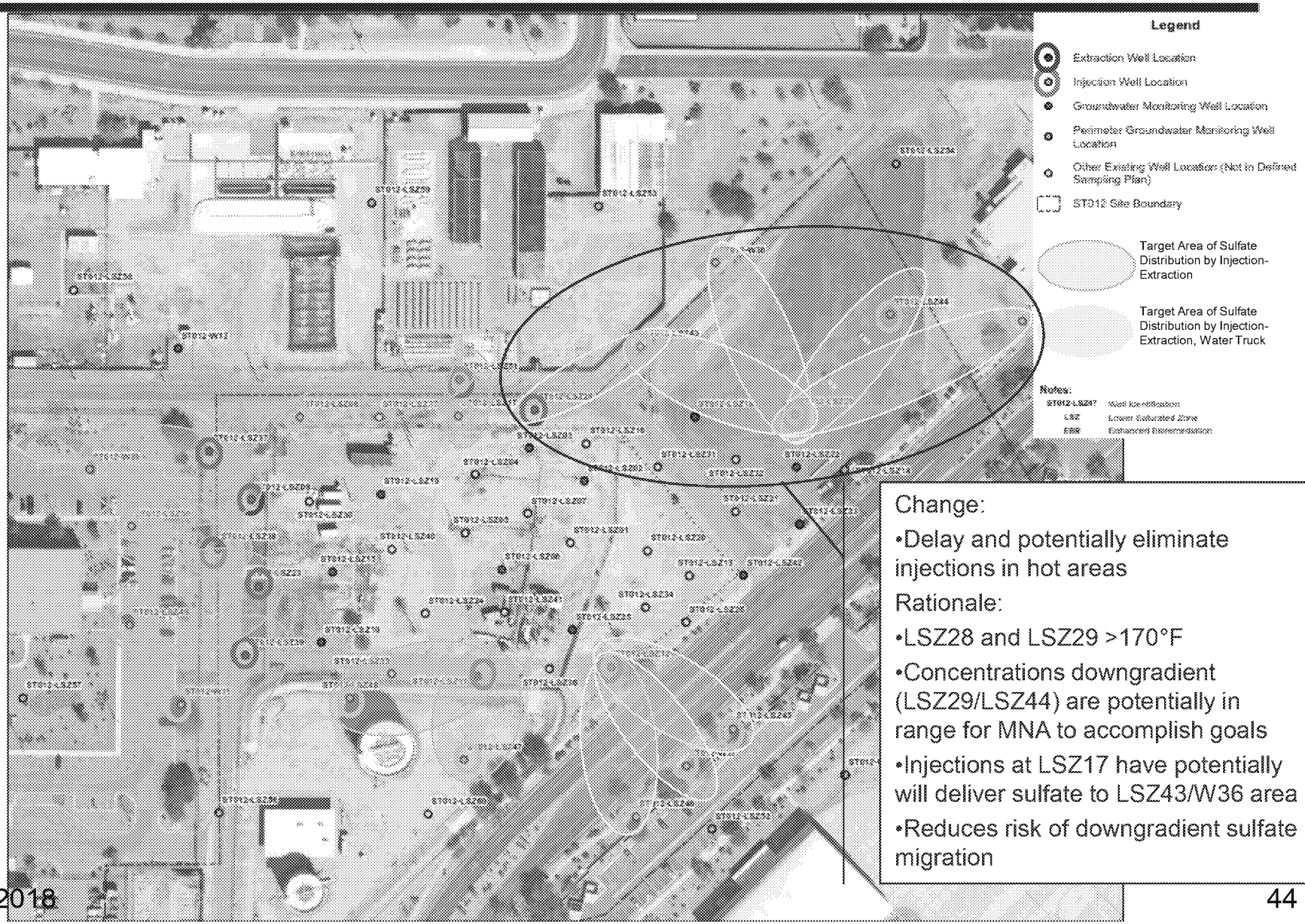
Site ST012 Injection Plan Adjustments

- **LSZ**
  - –Delay and potentially eliminate injections in hot areas

Rationale:

- –LSZ28 and LSZ29 >170°F
- –Concentrations downgradient (LSZ29/LSZ44) are in range for MNA to accomplish goals
- –Injections at LSZ17 will deliver sulfate to LSZ43/W36 area
- –Reduces risk of downgradient sulfate migration

Site ST012
LSZ Locations and Sequences



Change:

- Delay and potentially eliminate injections in hot areas

Rationale:

- LSZ28 and LSZ29 >170°F
- Concentrations downgradient (LSZ29/LSZ44) are potentially in range for MNA to accomplish goals
- Injections at LSZ17 have potentially will deliver sulfate to LSZ43/W36 area
- Reduces risk of downgradient sulfate migration

Site ST012 Activities May-Jul

- **Continued SVE operation**
- **EBR**
  - **Change out extraction pumps** — **25-29 Jun**
  - **Continue to check LNAPL accumulation/recovery** — **Ongoing**
  - **Injections** — **~9 Jul**
  - **Resample CZ23** — **~9 Jul**